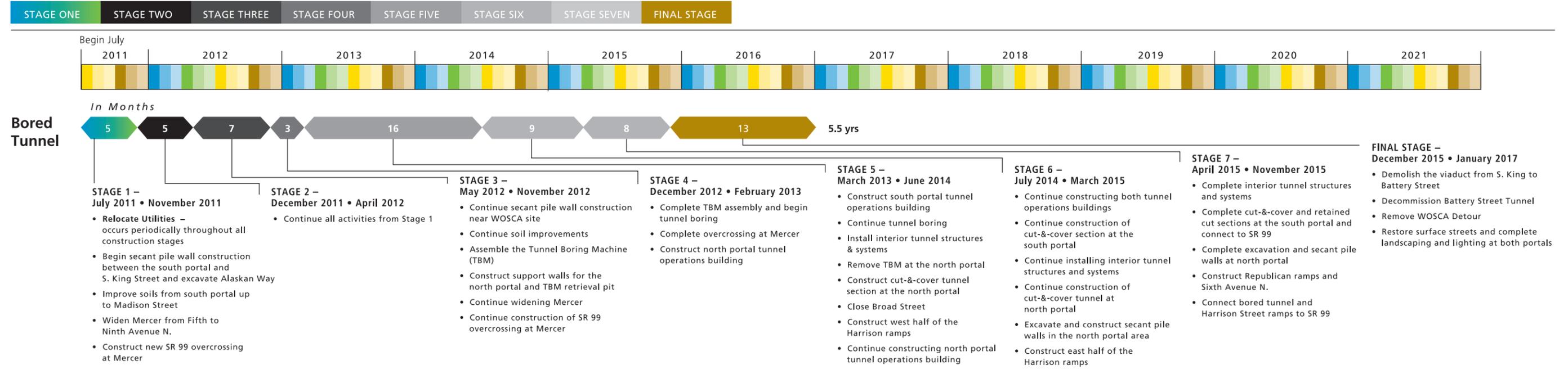


Construction Activities Chart



Note: Timeline extends to 2021 for comparison to other alternatives in Chapter 8.

CHAPTER 6 - CONSTRUCTION

What's in Chapter 6?

This chapter describes construction activities (Questions 1–10), temporary construction effects (Questions 11–36), and mitigation (Question 37) for the Bored Tunnel Alternative.

CONSTRUCTION METHODS

1 When would construction begin and how might construction activities be sequenced?

The Bored Tunnel Alternative construction activities are expected to begin around July 2011 and last for 5.5 years (66 months). Construction activities are described in eight stages. Expected activities, sequencing, and durations are shown on Exhibit 6-1. These activities, sequences, and durations may change as design continues and will be updated in the Final Environmental Impact Statement (EIS). State Route 99 (SR 99) would remain open to traffic throughout the majority of the construction period. Lane closures would be required on some city streets throughout construction.

2 How would construction of the S. Holgate Street to S. King Street Viaduct Replacement Project and construction of the Bored Tunnel Alternative overlap?

Construction of the north end of the S. Holgate Street to S. King Street Viaduct Replacement Project would overlap with construction of the Bored Tunnel Alternative between approximately S. Royal Brougham Way and S. King Street through early 2014. If no decision is made on how to replace the viaduct along the central waterfront, the S. Holgate Street to S. King Street Viaduct Replacement Project would be built to reconnect to the existing structure with the new ramps to Alaskan Way S.

However, a Record of Decision (ROD) on replacing the central waterfront portion of the viaduct is expected in mid-2011. If the Bored Tunnel Alternative is selected, the Alaskan Way Viaduct Replacement Project would then be responsible for connecting SR 99 from just north of S. Royal Brougham Way to the south portal of the tunnel.

The S. Holgate Street to S. King Street Viaduct Replacement Project will remove the viaduct structure up to Railroad Way S. and construct the Washington-Oregon Shippers Cooperative Association (WOSCA) detour beginning about November 2010. Traffic on the SR 99 mainline would begin to use the WOSCA detour beginning about December 2011. If the Bored Tunnel Alternative is selected, it would also use the WOSCA detour. In this case, the traffic impacts that are associated with the WOSCA detour would be considered part of the effects of the Bored Tunnel Alternative rather than the S. Holgate Street to S. King Street Viaduct Replacement Project around May 2012.

3 What must happen before construction can begin?

Once the Final EIS is published, the Federal Highway Administration (FHWA) will issue a ROD. The ROD will be issued no earlier than 30 days after the Final EIS is published. Construction cannot begin until the ROD is issued and required permits are obtained. The ROD will contain mitigation to avoid, minimize, and mitigate short- and long-term project effects. As the project progresses after the ROD, the lead agencies will work to obtain permits, finish right-of-way acquisitions, procure needed equipment, and hire contractors.

4 How would the Bored Tunnel Alternative be built at the south portal?

The following activities would take place near the south portal area:

- Improve soils
- Strengthen and support the existing viaduct
- Construct the tunnel's south portal
- Build the temporary electrical substation to power the tunnel boring machine (TBM)
- Support tunnel boring activities and remove tunnel spoils
- Connect the tunnel portal to SR 99 and restore surface streets

Improve Soils

Soil improvements and stabilizing measures are needed along the bored tunnel alignment to protect existing structures and utilities from settlement and to strengthen existing soil so that it can better accommodate tunnel construction. Soil improvements would be needed for construction of the south portal between S. Royal Brougham Way and S. King Street where most of the existing soils are fill material. Soil improvements are also needed in several locations along the bored tunnel alignment between S. King Street and Seneca Street, where soil types are more vulnerable to settlement and the tunnel would be at a relatively shallow depth. To avoid potential archaeological deposits, no soil improvements are planned between S. Main and S. Washington Streets. Soil improvements may be used to prevent settlement in several locations between S. Washington Street and Seneca Street. Near the north portal, between John and Thomas Streets, soil improvements may also be considered. Soil

Chapter 8 Comparison of Alternatives

Construction impacts for the Bored Tunnel, Cut-and-Cover Tunnel, and Elevated Structure Alternatives are compared in Chapter 8.

What is grout?

Grout is a cement-like mixture used for filling spaces.

improvement activities and stabilizing measures would occur throughout most of the construction period and could use the following methods:

- **Permeation grouting** – This is a soil improvement process in which grout is injected (by permeation) into the soil to displace the air and/or water occupying natural pore space.
- **Compaction grouting** – This is a process that injects grout into soil to form a grouted “bulb” that displaces and consolidates the soil.
- **Compensation grouting** – This is a type of grouting that would use a controlled grout injection process that distributes grout into the ground from either drilled access shafts near the buildings or from the ground surface through small-diameter injection pipes. The pipes could be installed along the perimeter of the buildings and angled to reach the target areas under buildings, filling voids in the soil.
- **Ground freezing** – This is a process by which heat is extracted from a water-saturated soil mass, temporarily converting pore water to ice, resulting in a consolidated soil mass as long as it remains frozen.
- **Underpinning** – This is a stabilizing measure that involves a building foundation support system to temporarily support vulnerable structure during construction.

Along with these soil improvements and stabilizing measures, an extensive and continuous monitoring process would be used to provide early warning when soils settle beyond specific thresholds. These processes have been used in Europe under historic buildings and have been found to control settlement to within 22 millimeters,¹ about $\frac{3}{4}$ of an inch. Advance measures would be taken to prevent settlement, but unanticipated settlement could occur along the bored tunnel alignment. If settlement

does occur, emergency measures would be required to repair damage or to minimize further settlement. Emergency measures could require injecting grout from the ground surface to stabilize soils in adjacent areas or from within the tunnel. Soil stabilization measures could require closing traffic lanes, sidewalks, or access to basements of adjacent buildings.

Strengthen and Support the Existing Viaduct

During south portal construction, the existing viaduct would be protected so that it remains safe for traffic. The Washington State Department of Transportation (WSDOT) would determine what measures are needed to strengthen the existing viaduct while construction and tunnel boring activities are underway. Possible methods that may be used are discussed below.

Between the First Avenue S. ramps and Columbia Street, plastic sheets that are reinforced with carbon fibers may be wrapped around the structure to strengthen the beams that support the roadway deck. Steel rods may also be used to strengthen the concrete beams.

Soil improvement methods and stabilization measures may also be used to support the existing viaduct from S. Washington Street to just north of Yesler Way, where the TBM would cross under the structure. Before the tunnel boring begins, columns of jet grout could be injected into soils to prevent the existing viaduct foundations from settling when the TBM bores under the structure. In addition, hydraulic jacks could be installed on each column. If the column foundations at a location settle differently, the jacks could be raised or lowered to keep the beams that support the roadway deck level.

Construct the Tunnel’s South Portal

Construction at the south portal would begin by building secant pile walls between S. Royal Brougham Way and S. King Street to support excavation for the tunnel portal. South portal construction includes excavating a deep cut into the Alaskan Way S. right-of-way on the north end of the WOSCA property, where the TBM would be launched. The WOSCA property is located west of First Avenue S.

and extends from S. Royal Brougham Way to Railroad Way S. Many of the construction activities for the bored tunnel would be conducted on the WOSCA property, including storage of construction materials and excavated soils and TBM maintenance. Construction offices would be located on the WOSCA property. A temporary electrical substation would be built on the WOSCA property to provide power to the TBM. A bentonite slurry separation plant and concrete batch plant may also be located on the WOSCA property, if needed.

Between 400,000 and 450,000 cubic yards of material would be generated from proposed excavations in the south portal area, depending on the option selected. All of this material would likely require off-site disposal. Demolition, foundation installation, and soil improvement activities would also generate some additional spoils, but the quantities are not yet known.

Within the excavation area for the south portal, a base would be built to support the assembly and launching of the TBM. The base would be a concrete and steel cradle that would include an approximately 9-foot-thick reinforced concrete slab.

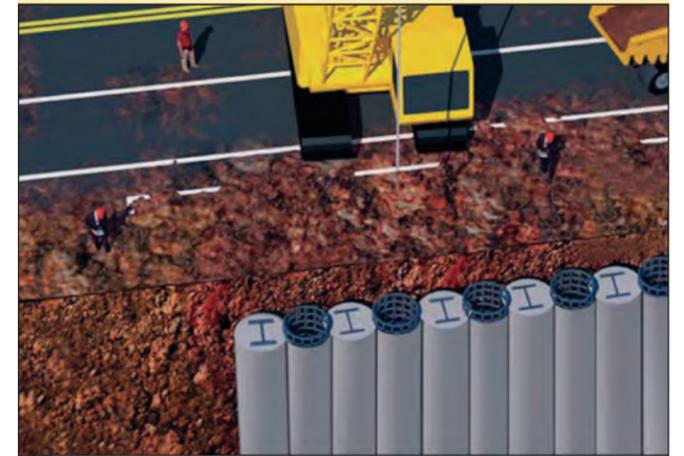
Dewatering may be required throughout construction, particularly at the south portal area, to control groundwater flow into the excavated areas that are below the water table. Ground settlement that may result from dewatering activities would be mitigated with reinjection wells near the excavation area, supplied by water from the dewatering operation. Excess water would be treated and disposed of in the sanitary sewer under King County Wastewater Discharge Permit conditions.

Build the Temporary TBM Electrical Substation

The TBM would require its own electrical substation to provide power during construction of the bored tunnel. The TBM substation would be built on the WOSCA property. It would be about 75 feet by 125 feet and no more than two stories tall.

What are secant pile walls?

A secant pile wall is a type of retaining wall that is built by placing two concrete drilled shafts apart from each other. Then another shaft is placed between the first two shafts. This forms a continuous wall of interlocking shafts, called a secant pile wall.



How would the WOSCA property be used during construction?

The WOSCA property, which is owned by WSDOT, is located west of First Avenue S. and stretches from S. Royal Brougham Way to about Railroad Way S. The south tunnel portal would be constructed just north of this property in the Alaskan Way S. roadway. The site would be used to begin and stage tunneling activities.

What are spoils?

Spoils consist of soil along with other debris that is removed during a construction activity.

¹ Littlejohn. 2009.

Support Tunnel Boring Activities and Remove Spoils

The south portal area would support tunnel boring activities. It would serve as the launching point for the TBM and the location where excavated material from the bored tunnel would be processed, stockpiled, and transferred into trucks, railcars, or barges for off-site disposal. It would also serve as a launching point for constructing the tunnel's interior structures.

Connect the Tunnel Portal to SR 99 and Restore Surface Streets

Once tunnel boring activities are completed, the on- and off-ramps to SR 99 would be built. Up to a 3-week closure would be required to connect SR 99 to the new bored tunnel and ramps.

The surrounding surface streets, such as First Avenue S. and Alaskan Way S., would be restored. The East Frontage Road and new surface streets would be constructed between S. Royal Brougham Way and S. King Street, connecting First Avenue S. and Alaskan Way S. Landscaping, trails, and sidewalk improvements would be incorporated into surface roadways.

5 How would the bored tunnel section be built?

The TBM would be launched near S. King Street. When the tunnel bore is complete, the TBM would be disassembled and removed at the north portal construction staging area.

Bored tunnel construction would include the following activities:

- Set up the staging area at the WOSCA property to support tunnel excavation and construction (discussed previously in Question 4).
- Select, procure, assemble, and launch the TBM.
- Drive the TBM.
- Remove soil and spoils.
- Construct the internal tunnel structure and roadway.
- Remove the TBM.
- Install fire and life safety systems, power, lighting, ventilation, fire alarm,

sprinkler system, traffic signs, and communication system.

Select Tunnel Boring Machines

Three types of tunneling machines in use today are being considered: an earth pressure balance TBM, a slurry pressure face TBM, and a hybrid earth pressure balance-slurry TBM. These machines mine below the groundwater table and stabilize the tunnel face to minimize surrounding ground movements and settlement above the tunnel. To support the excavation, a concrete liner is installed in segments as the TBM advances. The three types of TBMs differ in how they maintain the pressure balance at the face of the tunnel:

- **Earth pressure balance machine** – This TBM maintains pressure at the face by retaining excavated soil in a chamber behind the cutterhead and balancing the rate of advance of the TBM with the rate of discharge of the excavated material.
- **Slurry pressure face machine** – This TBM maintains pressure at the face with a mixture of soil cuttings and bentonite slurry. This type of TBM would require construction of a slurry separation and concrete batch plant near the south portal.
- **Hybrid earth pressure balance-slurry machine** – This TBM uses a combination of earth pressure and slurry pressure to stabilize soils. This type of TBM would also require construction of a slurry separation and concrete batch plant near the south portal.

The TBM for the project would be approximately 54 feet tall and at least 400 feet long with all of the equipment trailing behind it. Exhibit 6-2 shows what a TBM looks like as it is being assembled.

Drive the TBM and Remove Soils

Driving the TBM through the proposed tunnel alignment is estimated to take approximately 1 year, assuming an

average rate of advancement of approximately 30 feet per day.

While the TBM is advancing, approximately 808,000 cubic yards of soil would be excavated. A small amount of ground loss typically occurs as boring proceeds, and if not properly controlled, could lead to the settlement of buildings or other structures, including utilities. Ongoing coordination with utility providers is taking place, and mitigation is being developed. If settlement or vibration were to damage utility lines during tunnel boring, emergency repairs would be required. Provision for such emergency repairs is part of the ongoing coordination between agencies.

Excavated materials would include soil mixed with water, other additives, or slurry. Depending on the type of TBM used, a slurry separation plant may be needed to process excavated material. If needed, it would likely be located on the WOSCA property. For slurry pressure face TBMs, the slurry and excavated material would be wet and would be transported through pipes to the slurry separation plant. A slurry separation plant typically includes an arrangement of conveyors, pumps, centrifuges, filters, and sumps. At the plant, the slurry would be separated from the excavated soil, allowing the slurry to be recycled and reused as tunnel excavation proceeds. After separation, the remaining wet soil spoils could be stockpiled and loaded into trucks, railcars, or barges for off-site disposal.

If an earth pressure balance TBM is used, the excavated spoils would consist of mud with a toothpaste-like consistency. Soils would likely be removed from the tunnel using a conveyor system or muck train. The material would then be stockpiled and removed by truck or conveyed to a staging area at Terminal 46, where it could be placed on a barge. If materials are barged, a possible off-site disposal location would be the Mats Mats quarry in Jefferson County, Washington.

Construct Internal Tunnel Structure and Roadway

The tunnel would be lined with precast concrete segments as it is excavated. Regardless of the type of TBM used, the



Tunnel Boring Machine Being Assembled

SOURCE: WWW.HERRENKNECKT.COM

What volume of soil would be excavated for the bored tunnel?

Bored tunnel construction would remove approximately 808,000 cubic yards of material. This volume of material is enough to cover a football field with soil 378 feet deep. As a comparison, the Qwest Field roof is about 200 feet high.

internal walls and roadway decks may be constructed with a combination of precast components fabricated off site and cast-in-place concrete for specialized tunnel components. Two levels of deck would be installed in the tunnel to support two lanes of traffic in each direction.

Remove TBM

Tunnel boring would end near Thomas Street. A pit would be excavated to remove the TBM, and the machine would be dismantled and extracted just north of Thomas Street in the north portal construction staging area.

Install Internal Tunnel Systems

After the internal structures have been completely installed, components relating to mechanical, electrical, and control/instrumentation systems would be installed throughout the bored tunnel and portals. Once the bored tunnel construction is completed, the structures to connect the tunnel to existing SR 99 and the surrounding surface streets would be completed.

6 How would the Bored Tunnel Alternative be built at the north portal?

The following activities would take place near the north portal area:

- Construct the north tunnel portal
- Connect the north tunnel portal to SR 99
- Construct and restore surface streets

Construct the North Tunnel Portal

Tunnel boring would end at Thomas Street. Soils would be excavated between Thomas and Harrison Streets so the TBM could be dismantled and extracted. North portal construction would begin by building retaining walls along the eastern and western boundaries of the SR 99 alignment. The interior structures housing the northbound and southbound roadway decks and connections to the tunnel ventilation structures would be built within the excavation. The bored tunnel would transition to a cut-and-cover section, which would transition to a retained cut and finally an at-grade surface roadway at Roy Street. Based on the current level of design,

an estimated 210,000 to 240,000 cubic yards of spoils would be generated from proposed excavations in the north portal area.

Connect the North Tunnel Portal to SR 99

At the north portal, the new SR 99 alignment would be about one block west of the existing SR 99 roadway. The new roadway would then curve east and connect with the existing SR 99 roadway near Mercer Street. A northbound on-ramp and southbound off-ramp would be constructed at the intersection of Harrison Street and Aurora Avenue. A northbound off-ramp and southbound on-ramp would be constructed at Republican Street.

Construct and Restore Surface Streets

Aurora Avenue would be filled and restored to grade between the Battery Street Tunnel and John Street. John, Thomas, and Harrison Streets would be connected across Aurora Avenue. Signalized intersections would be built at Denny Way and John, Thomas, and Harrison Streets. During construction, there would be periodic lane closures to relocate utilities on these streets as well as Denny Way and Sixth Avenue N.

Sixth Avenue N. would be extended north to connect with Mercer Street. Broad Street would be closed between Ninth and Taylor Avenues N. about a year and a half into construction, then backfilled and replaced by the newly connected street grid. Landscaping and sidewalk improvements would be incorporated into the reconstruction of surface roadways and intersections.

Mercer Street would be widened to become a two-way street with three lanes in each direction with left-hand turn pockets. Two lanes would be closed from Dexter Avenue N. to Fifth Avenue N. for about the first year and a half of construction while Mercer Street is widened and a new SR 99 bridge is built over the roadway.

7 Where would tunnel operations buildings be built?

The Bored Tunnel Alternative would have a tunnel operations building at each portal. Near the south portal, the building would be constructed in the block bounded

by S. Dearborn Street, Railroad Way S., and Alaskan Way. Near the north portal, the building would be constructed between Thomas and Harrison Streets, just east of Sixth Avenue N. Part of the tunnel operations buildings would be constructed underground. The remaining portion of each building is expected to be approximately 60 to 65 feet tall, with vent stacks extending up to 30 feet above the roof.

The tunnel operations buildings would control the exhaust fans that provide ventilation to the tunnel. The buildings would also monitor the electrical and fire-suppression systems that serve the tunnel. The north tunnel operations building would also include a center where staff would monitor traffic and maintain tunnel operations.

8 How would the viaduct be removed?

Demolition of the viaduct is anticipated to begin in January 2016, early in Stage 8, and take 9 months. Viaduct demolition would generate approximately 107,000 cubic yards of material, primarily broken concrete and reinforcing steel that would need to be hauled away and disposed of. Some of the concrete may be used to fill the Battery Street Tunnel if the Bored Tunnel Alternative is chosen. Additional material would be hauled away in trucks, railcars, or barges to a predetermined disposal site.

Utilities attached to the viaduct would be relocated before the viaduct is demolished. Utilities would be relocated underground, which would require excavation under the existing viaduct. Most utilities buried beneath the viaduct are not expected to be affected by viaduct demolition or removal of the viaduct columns to a depth of 5 feet below the existing grade. Soil disturbances more than 5 feet below the existing grade have the potential to disturb deeper utilities. Mitigation measures, such as timber mats or gravel beds, would be used to ensure that utilities buried beneath the viaduct would not be damaged during viaduct demolition.

Viaduct demolition activities are assumed to require two shifts per day, 5 days per week in the north and south

portal areas, and two shifts per day, 6 days per week along the central waterfront. Two construction teams would be working at the same time in different locations. Viaduct demolition and removal would occur from just south of S. King Street to the Battery Street Tunnel. Equipment used to remove the viaduct would include extended-arm trackhoes with concrete-pulverizing attachments (concrete munchers), trackhoes with a concrete-breaking hammer attachment, manlifts, forklifts, track-mounted backhoes, and several pickup trucks and dump trucks.

Concrete munchers would be used in locations adjacent to existing businesses or residences to control the size and dispersion of concrete debris. Water would be used to control dust created during demolition activities. Signs, fences, traffic control flaggers, and possibly uniformed police officers may be used to keep pedestrians and vehicles away from the construction work zone. Materials from viaduct demolition would be broken concrete and severed reinforcing steel. A smaller concrete-breaking hammer would be used to further separate the concrete from the reinforcing steel, and these materials would be placed into separate stockpiles.

9 What would happen to the Battery Street Tunnel?

The Battery Street Tunnel would be decommissioned and closed after the bored tunnel is open to traffic. As part of the Battery Street Tunnel decommissioning process, the tunnel may require remediation to remove soot containing high levels of lead and to remove asbestos within the tunnel. Decommissioning would also include disconnecting power, water, and drainage lines. The necessary utilities that run through the tunnel would be relocated, and materials such as lighting fixtures would be removed. Then the tunnel would be filled with suitable material (such as the concrete rubble from viaduct demolition), and all street access vents and both portals would be sealed. The rubble would be solidified with a concrete mix. The Battery Street Tunnel portals would be sealed with concrete and barricaded. These activities would periodically disrupt Battery Street, located on top of the tunnel, and may require occasional evening and/or weekend closures.

10 What construction shifts are proposed?

Construction for all activities could occur up to 24 hours per day, 7 days per week within permitting requirements. However, proposed construction activities and shifts are likely to vary depending on the location and type of construction activity. In the north portal area, construction would likely occur 6 days per week with two shifts per day. Tunnel boring and work at the WOSCA staging area in the south portal area would likely occur in three shifts per day, 6 days a week. TBM maintenance activities would be performed 1 day a week when tunnel boring is not occurring. Viaduct demolition is expected to occur 5 or 6 days a week with two shifts per day.

11 Where would construction staging areas be located?

Space for potential construction staging is limited adjacent to the portal areas, so some staging areas are proposed outside of the immediate project area. Construction staging areas are shown on Exhibit 6-3 and described below:

- **Terminal 106** – This site may be used as a construction staging, materials fabrication, and laydown area. Materials would be fabricated outside the 200-foot shoreline boundary.
- **Terminal 25** – This site may be used as a temporary holding area for excavated spoils. Spoils would be transported to the site by trucks. This site could also be used for materials fabrication, but this activity would occur outside the 200-foot shoreline boundary.
- **WOSCA Property** – This site would be used as a staging area for tunnel-boring activities, which would include assembling the TBM, holding and transporting spoils, and serving as a launch site for installing interior tunnel structures. Part of the site would be used for a traffic detour. The site would also be used for a temporary electrical substation needed to support the TBM and for construction offices. The site may also be used for a slurry separation plant or concrete batch plant, if needed.

Proposed Construction Staging Areas



Exhibit 6-3

- **Pier 48, Uplands Only** – This property may be used for construction parking.
- **Pier 46** – Pier 46, at the northern edge of Terminal 46, may be used to accommodate excavated materials that would be barged for off-site disposal. The site may include the construction of a conveyor and hoppers to transfer materials to the barge. Container activity on the rest of Terminal 46 would not be affected.
- **Interstate 90 (I-90) high-occupancy vehicle (HOV) Ramp Site** – This site is under the HOV ramps and would be used primarily for storage.
- **Alaskan Way S., S. King to S. Jackson Street Site** – This site would be used for soil improvements.
- **Railroad Way S. Right-of-Way** – During much of the construction period, the right-of-way along Railroad Way S. under the First Avenue S. ramps would be used to accommodate south portal construction activities. During the last year of construction, the area would be used to demolish the existing ramps.
- **Alaskan Way S., S. Royal Brougham Way to S. King Street** – This project work zone and construction staging area (6-acre site) would eventually become the location of the permanent roadway connecting SR 99 to the new bored tunnel.
- **First Avenue S. Bridge Site** – This site would be used primarily for storage.
- **Fischer Site (Fourth Avenue S., formerly an SR 519 project staging site)** – This site would be used primarily for storage but could also be used for fabricating materials.
- **I-90 Ramp Site** – This site would be used primarily for storage.
- **Broad Street Right-of-Way** – Once Broad Street is closed, this area may be used for construction staging and storage.
- **Construction Zone in City of Seattle Right-of-Way** – This strip of right-of-way along the existing viaduct would be used for viaduct demolition.
- **Seattle City Light Parking Lot South of the Battery Street Tunnel** – This site would be used primarily for storage.
- **North Portal Construction Staging Area** – This area would be used for construction staging, closing and backfilling of Broad Street, and TBM retrieval.
- **BNSF/Lenora Street Construction Zone** – This strip of right-of-way between approximately Pine Street and Bell Street, would be used for material storage, viaduct demolition, and resurfacing of Alaskan Way.

Except for Terminal 106, Terminal 25, and Pier 46, which are owned by the Port of Seattle, all of the potential staging areas for the Bored Tunnel Alternative are already owned by WSDOT or are other public rights-of-way. WSDOT and the Port of Seattle are developing agreements for the potential use of the Port of Seattle properties.

TRAFFIC EFFECTS DURING CONSTRUCTION

12 How would SR 99 be restricted during construction?

Construction activities are described in eight stages for the Bored Tunnel Alternative. Exhibit 6-4 shows a proposed traffic detour and roadway restrictions during construction. SR 99 would remain open for most of the construction period but would be closed for approximately 3 weeks at the end of construction Stage 7 (about 4.5 years into construction) to connect SR 99 to the bored tunnel. Periodic night or weekend closures of SR 99 would also be required.

When construction begins for the Bored Tunnel Alternative, restrictions in the south portal area would mostly be due to construction of the S. Holgate Street to S. King Street Viaduct Replacement Project, which would already be constructing the WOSCA detour and would open the temporary northbound on-ramp and southbound off-ramp. The S. Holgate Street to S. King Street Viaduct Replacement Project would reconfigure the existing SR 99 ramps to First Avenue S. and use them to route SR 99 mainline traffic to and from the WOSCA detour. A temporary southbound off-ramp would be located near S. Atlantic Street, and a temporary northbound on-ramp would be located at S. Royal Brougham Way. The S. Holgate Street to S. King Street Viaduct Replacement Project would move the mainline SR 99 traffic to the WOSCA detour in two phases: first the southbound traffic would be detoured for about 5 months, and then both northbound and southbound traffic would be detoured as shown on Exhibit 6-5. The detour would be put in place during Stage 2 and the beginning of Stage 3 of the Bored Tunnel Alternative construction. Construction of the Bored Tunnel Alternative would extend the time that the WOSCA detour is needed by about 2 years beyond what is required for the S. Holgate Street to S. King Street Viaduct Replacement Project. The temporary ramps that are part of the detour would also remain in place through Stage 7 of the Bored Tunnel Alternative construction. The WOSCA detour would have a posted speed limit of 25 miles per hour (mph).

SR 99 would be reduced by one lane in each direction throughout most of the construction period for the Bored Tunnel Alternative. This is because there is only enough space for two lanes in each direction through the WOSCA detour in the south as well as through the north portal area. Traffic would be constrained in the north portal area to construct the new SR 99 ramps and bridge across Mercer Street. On the existing viaduct, traffic would be reduced from three lanes to two lanes, except for the northbound lanes between the First Avenue S. ramps and the Western Avenue off-ramp, which would have three lanes to accommodate traffic exiting at the Seneca Street

Assumptions for the Construction Traffic Analysis

The transportation analysis for construction modeled conditions during Stage 7, which is 8 months long and considered to be the most disruptive to traffic. During this stage, SR 99 traffic would be using the WOSCA detour, Broad Street would be closed, and Mercer Street would be a two-way street. SR 99 would continue to be reduced to two lanes in each direction through most of the project area until the last 3 weeks of Stage 7 when SR 99 would be closed to all traffic.

Construction Roadway Closures, Restrictions, and Detour

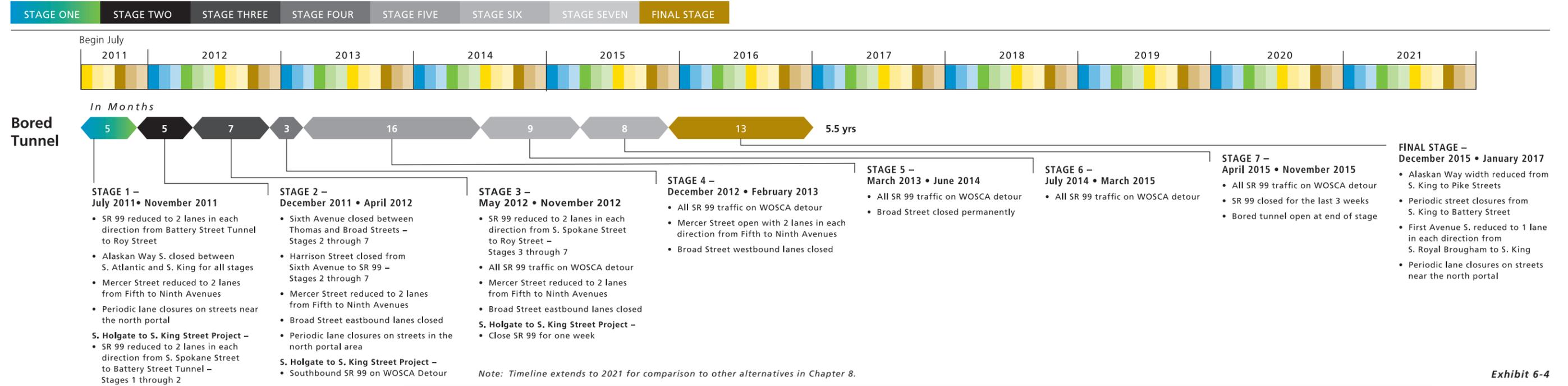


Exhibit 6-4

and Western Avenue off-ramps. The speed limit on the existing viaduct would be reduced from 50 mph to 40 mph.

13 How would SR 99 traffic be affected by lane restrictions?

Restricting the speed limit and number of lanes on SR 99 and routing the mainline traffic onto the WOSCA detour would reduce SR 99 capacity during the first 4.5 years of construction. It was determined that the 8 months of construction during Stage 7, which includes a 3-week closure of SR 99 at the end of the stage, would be the most disruptive for the longest period of time. Average travel times prior to the 3-week closure were assessed for two typical SR 99 trips during construction Stage 7: Woodland Park to S. Spokane Street and Ballard to S. Spokane Street via the Alaskan Way Viaduct. Southbound trips in the AM peak hour (8:00 a.m. to 9:00 a.m.) are projected to increase by 1 to 3 minutes compared to travel times projected for the 2015 Existing Viaduct. Northbound trips in the AM peak hour are projected to increase by about 1 minute for trips to Woodland Park and about 7 minutes

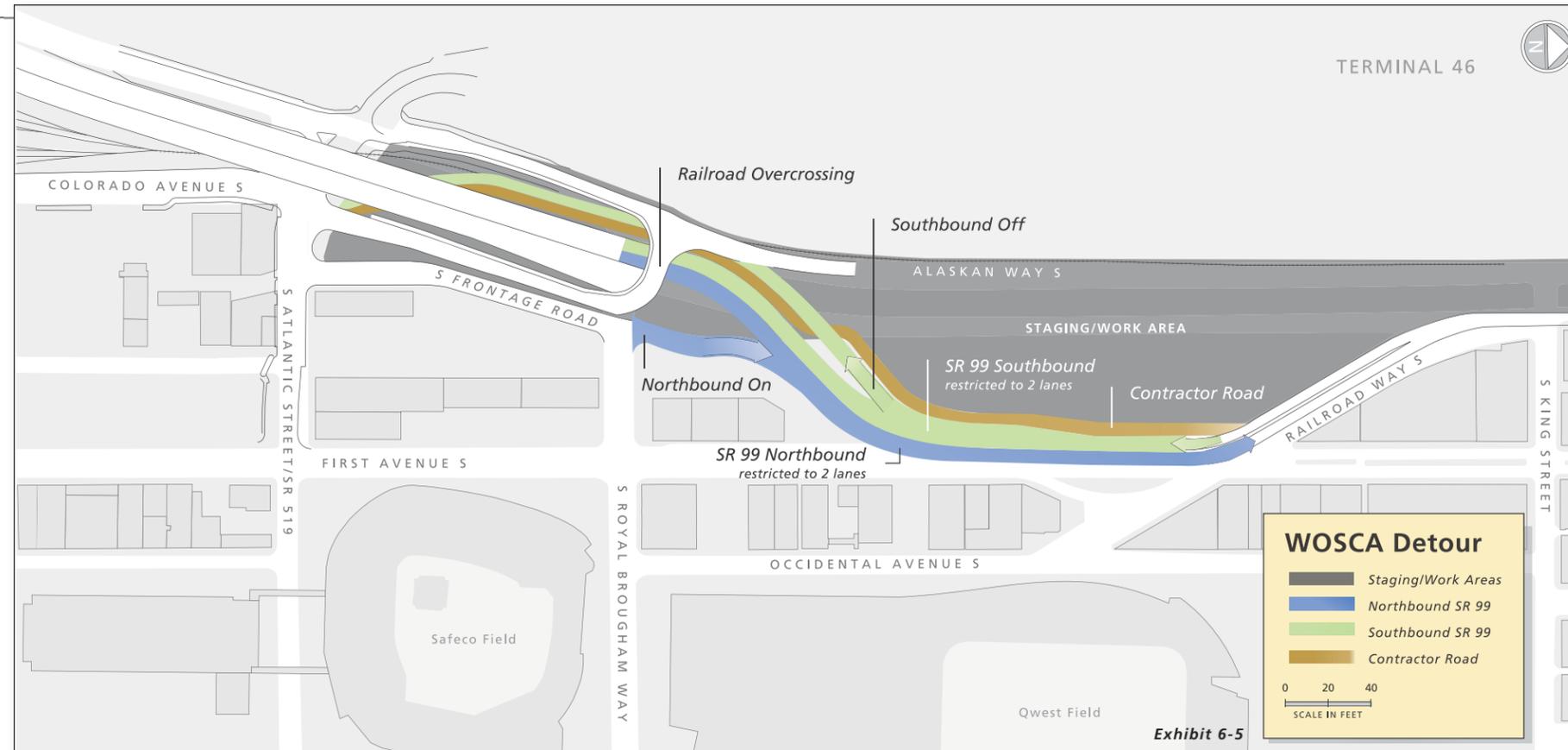


Exhibit 6-5

for trips to Ballard. Southbound trips in the PM peak hour (5:00 p.m. to 6:00 p.m.) are projected to increase by 1 to 2 minutes, and northbound trips are expected to stay the same or increase by up to 3 minutes compared to travel times projected for the 2015 Existing Viaduct. These increases in travel time would be similar during the first 4.5 years of construction until the bored tunnel is opened.

These results reflect average travel times. Traffic on SR 99 would be close to capacity during construction, and traffic would be more likely to experience increased delay and congestion when there is a disruption in traffic flow, such as an accident. The minimal increases in travel time are due in large part to reduced demand on SR 99. Demand would be reduced because of expected traffic bottlenecks on surface streets near the south and north portal areas of the viaduct that would likely cause many drivers to divert to other city streets, such as Second or Fourth Avenues and Interstate 5 (I-5), resulting in less overall traffic on SR 99.

SR 99 would be closed for 3 weeks to allow the connection of the completed bored tunnel to the south and north portals. During this closure, congestion on local arterials in the downtown core is expected to increase noticeably compared to congestion during other stages of construction because all SR 99 traffic would be diverted to city streets and other major freeways such as I-5 and I-90. Point-to-point travel times during the 3-week closure are expected to increase substantially. For example, a trip between Woodland Park and S. Spokane Street that typically takes about 15 minutes could take about 45 minutes.

14 How would local streets be restricted during construction?

As shown in Exhibit 6-4, in addition to SR 99 restrictions, a detour and roadway restrictions would be needed near the south and north tunnel portals and along the waterfront during viaduct demolition. Some restrictions would be short term, such as those associated with utility relocations and closures of cross streets during the demolition of the existing viaduct. Others, such as the closure of Alaskan

Way S. between S. Atlantic Street and S. King Street would continue for most of the 5.5-year construction period.

South Portal Roadway Restrictions and Detour

Alaskan Way S. would be closed between S. Atlantic Street and S. King Street to accommodate south portal construction activities. S. King Street would be closed between Railroad Way S. and Alaskan Way S. Traffic on Alaskan Way S. would be detoured at S. Atlantic Street to the East Frontage Road. From there, Alaskan Way S. traffic would be routed to S. Royal Brougham Way, to First Avenue S., and then to Railroad Way S., where it would be routed under the viaduct and connect back to Alaskan Way S. For about 4.5 years of the 5.5-year construction period, First Avenue S. would continue to have two lanes in each direction. During the last year of construction, after the bored tunnel is opened, First Avenue S. would be reduced to one lane in each direction.

North Portal Roadway Restrictions

In the north portal area, there would be periodic closures on Sixth Avenue N., Taylor Avenue N., and Broad Street for utility relocations during construction Stages 2 and 3. On Broad Street, the eastbound lanes would be closed for 12 months during Stages 2 and 3 and would reopen briefly in Stage 4, when the westbound lanes would be closed for 3 months. These closures will require detours for local traffic. Broad Street would be permanently closed in Stage 5.

Mercer Street would be reduced to two eastbound lanes between Fifth and Ninth Avenues N. during the first three stages of construction. In Stage 4, Mercer Street would become a two-way street with two lanes open in each direction. Mercer Street would increase to three lanes in each direction during Stage 5. These reductions will cause some delays, especially during peak hours. There would be periodic lane closures and restrictions for street construction on Denny Way; John, Thomas, and Harrison Streets; and Aurora and Sixth Avenues N. during Stage 8 that would require short detours.

Other Roadway Restrictions

Throughout most of the construction period, few long-term lane closures are expected for local streets located between the south and north portals. However, periodic lane closures would be required during demolition of the viaduct and to fill and close the Battery Street Tunnel. On Battery Street, short-term lane and street closures would likely be required as part of closing the Battery Street Tunnel. During the 9-month period when viaduct demolition occurs, Alaskan Way would be narrowed. Cross streets that pass under the viaduct would be temporarily closed between S. King Street and the Battery Street Tunnel. These closures will require detours for local traffic and cause some delays, especially during peak hours. Periodic lane closures would also be needed in specific areas along the bored tunnel alignment where soil improvements are needed and could cause short detours.

15 How would traffic on local streets be affected?

This section discusses anticipated congestion levels at intersections during construction Stage 7. During this stage, all SR 99 traffic would be using the WOSCA detour, Broad Street would be closed, and Mercer Street would be a two-way street. Vehicle delays at intersections in the project area are expected to increase. These increased delays would be influenced by the SR 99 lane restrictions in the south and north, which would reduce SR 99 to two lanes in each direction through most of the project area, would reduce speeds, would modify access, and could lead approximately one-third of drivers to use other routes, such as local streets or I-5. Modeling results indicate that this diverted traffic would have little effect on I-5 trips, but it would have a larger effect on trips diverting to local streets. Impacts to local streets are discussed below. Approximately two-thirds of the vehicles that travel on the viaduct today would continue to use SR 99 during construction.

South Portal Area

Delays at the majority of intersections investigated in the south would not change substantially during construction Stage 7 compared to delays projected for the 2015 Existing

What is the 2015 Existing Viaduct?

The 2015 Existing Viaduct describes projected traffic conditions in the project area in 2015, before the bored tunnel opens.

Viaduct. However, the temporary northbound on-ramp for the WOSCA detour may experience considerable queues during the PM peak. These queues could back up into adjacent intersection, affecting operations at the following locations:

- East Frontage Road/S. Royal Brougham Way
- First Avenue S./S. Royal Brougham
- First Avenue S./S. Atlantic Street

Delay is expected to increase by about 30 to 45 seconds at each of these intersections.

While SR 99 is reduced by one lane in each direction, some drivers may choose to use other routes such as First, Second, and Fourth Avenues, which may add congestion and increase delay at intersections along these routes. Delay at most of the intersections along First, Second, and Fourth Avenues is not expected to increase by more than 1 minute, with the following exceptions:

- First Avenue S./S. Washington Street during the PM peak hour (delay of 3 to 4 minutes)
- First Avenue S./S. Main Street during the PM peak hour (delay of more than 5 minutes)
- Second Avenue S./S. Jackson Street during the PM peak hour (delay of about 3 minutes)
- Fourth Avenue S./S. Royal Brougham during the PM Peak hour (delay of about 2 minutes)

Central Downtown and Waterfront Area

During construction Stage 7, peak hour volumes are expected to increase for the majority of intersections along north-south arterials such as First, Second, and Fourth Avenues. However, since these intersections would not be congested with the 2015 Existing Viaduct, the increase in volume during construction would not result in high levels of congestion for most of these locations. Exceptions include the intersection of Second Avenue and Marion Street during both the AM and PM peak hours and the

intersection of Fourth Avenue and Marion Street during the PM peak hour, where congestion would result in delays of 1 minute or more.

North Portal Area

The widening and conversion of Mercer Street to a two-way corridor and restrictions to SR 99 access between Denny Way and Mercer Street would increase congestion slightly compared to congestion projected for the 2015 Existing Viaduct. These access changes would shift a portion of the peak hour traffic to connections farther north or south.

Peak hour congestion levels at intersections near affected on- or off-ramp connections or along affected city streets would potentially increase due to higher concentrations of peak hour traffic demand and changes in ramp configuration during construction. At the Denny Way northbound on-ramp to SR 99, delays would increase by more than 1 minute in the PM peak hour. This area is already congested during peak hour traffic conditions, and the effects of construction activities and traffic diversion would likely increase delays and congestion during periods of increased demand. Mercer Street reconstruction would cause further increases in traffic volumes at the following locations:

- Mercer Street at Dexter Avenue N., delay is expected to increase by more than 1 minute during the AM peak hour
- Mercer Street at Fifth Avenue N., delay is expected to increase by approximately 1 minute during the PM peak hour
- Broad Street at Fifth Avenue N., delay is expected to increase by more than 3 minutes during the AM peak hour

16 How would specific SR 99 users be affected during construction?

How would south portal construction affect SR 99 drivers heading to or from downtown?

SR 99 would be reduced to two lanes in each direction, which would increase congestion on SR 99 and slow travel speeds, particularly during peak travel times. SR 99 would be restricted because there is only enough space for two lanes in each direction through the WOSCA detour in the south. Traffic in the north portal area would also need to be restricted to two lanes in each direction to allow construction of the new SR 99 ramps and bridge across Mercer Street. Despite the increased congestion, travel times are not expected to change much, due in part to decreased vehicle volumes on SR 99 as drivers choose to use other routes during construction. Approximately two-thirds of the vehicles that travel on the viaduct today would continue to use SR 99 during construction, and one-third of the vehicles would choose other routes such as local streets and I-5. Additionally, northbound on-ramps and off-ramps to First Avenue S. would be relocated onto a temporary on-ramp at S. Royal Brougham Way and off-ramp at S. Atlantic Street. The current weave caused by the left-side Columbia Street on-ramp and First Avenue S. off-ramp would be eliminated because the new temporary off-ramp would be located on the right side of southbound traffic.

During south portal construction, some drivers may choose to use other routes such as First, Second, and Fourth Avenues, which may add congestion and increase delay at intersections along these routes. In addition, construction activities would cause disruptions on streets such as S. Royal Brougham Way, S. Atlantic Street, Alaskan Way S., and E. Marginal Way S.

How would construction affect SR 99 drivers heading through downtown?

For much of the construction period, northbound and southbound SR 99 traffic would be reduced to two lanes in each direction in the south and north portal areas. These lane restrictions and the WOSCA detour would result in

Appendix C, Transportation Discipline Report

Traffic congestion on SR 99 and traffic congestion on surface streets during construction are discussed in *Appendix C, Sections 6.1.4 and 6.1.5*, respectively.

Additional information on transit and freight traffic during construction is also provided in *Sections 6.1.7 and 6.1.8*, respectively.

decreased travel speeds, especially during peak travel times. During peak travel times, average SR 99 travel times for through trips are expected to increase by about 1 to 7 minutes for trips from Woodland Park to S. Spokane Street and from Ballard to S. Spokane Street via the Alaskan Way Viaduct. The average demand for through trips is projected to be less than the demand projected for the 2015 Existing Viaduct because drivers would choose different routes to avoid congestion and delays on SR 99. Drivers may choose to use other north-south arterials such as First, Second, and Fourth Avenues or I-5. Congestion is expected to increase on these roadways.

How would construction affect SR 99 drivers heading to or from northwest Seattle (Ballard, Interbay, and Magnolia)?

Drivers who use the Elliott and Western Avenue ramps would continue to be able to use these ramps until the viaduct is demolished in the last year of construction. Congestion on SR 99 would cause some delay, but access to Ballard and Interbay would not change substantially. Southbound trips between Ballard and S. Spokane Street in the AM peak hour (8:00 a.m. to 9:00 a.m.) are projected to increase by 3 minutes compared to travel times projected for the 2015 Existing Viaduct. Northbound trips in the AM peak hour are projected to increase by about 7 minutes for trips to Ballard. Southbound trips in the PM peak hour (5:00 p.m. to 6:00 p.m.) are projected to increase by 1 to 2 minutes, and northbound trips are expected to stay the same or increase by up to 3 minutes compared to travel times projected for the 2015 Existing Viaduct. Once the viaduct has been demolished and the bored tunnel is open, drivers traveling from northwest Seattle would need to either use Mercer Street to access the new bored tunnel via the on-ramp at Sixth Avenue N. and Republican Street or travel on Elliott Avenue to Alaskan Way to access SR 99 near S. King Street.

How would construction of the north portal affect SR 99 drivers heading to or from downtown?

Construction activities would result in disruptions for drivers on SR 99 and on several streets within the north portal area throughout the construction period. SR 99 would be restricted to two lanes in the northbound

direction from Harrison Street to Mercer Street and in the southbound direction from Broad Street to Harrison Street during Stages 1 through 7. Broad Street would have the eastbound or westbound lanes closed for 15 months in Stages 2 through 4 before being permanently closed in Stage 5. Mercer Street would be restricted while it is being widened and converted to a two-way corridor. These lane restriction and access changes would cause some increase in congestion on local streets, particularly Sixth Avenue N., Dexter Avenue N., Denny Way, and John, Thomas, Harrison, and Republican Streets. These surface streets currently operate under capacity on a typical day; therefore, increases in traffic volumes due to construction would not cause highly congested conditions. However, at the Denny Way northbound on-ramp to SR 99, delays would increase by more than 1 minute in the PM peak hour. This area is already congested during peak traffic conditions, and the effects of construction activities and traffic diversion would likely increase congestion during times of increased demand. Additionally, the Mercer Street reconstruction would add more than 1 minute of delay during the AM peak hour at the Mercer Street and Dexter Avenue N. intersection due to increases in north-south traffic volumes.

How would construction affect freight?

Freight mobility and access would be affected by lane closures and traffic congestion during construction. Lane reductions on SR 99 would affect many drivers, including freight operators, and cause increased congestion on alternative routes. Construction vehicles on routes used for hauling construction materials and spoils to and from the south portal area may also cause delays for some freight traffic. In the south portal area, the primary route for hauling construction materials would likely include the temporary SR 99 off-ramp to S. Atlantic Street to SR 519 (Edgar Martinez Drive S.) to First Avenue S. Construction vehicles transporting over-legal loads to the south end of the project area would likely travel via West Marginal Way S. (SR 599) to First Avenue S.

Routes being considered for hauling construction materials and spoils in the north portal area include I-5 to

Fairview Avenue N. to Denny Way to Sixth Avenue N. to the construction zone. SR 99 to and from the north is also available as a potential haul route.

How would construction affect transit?

King County Metro bus services that use SR 99 would be affected by lane and speed restrictions on SR 99 during construction. However, the outside lane of northbound SR 99 north of the S. Spokane Street interchange would be a transit-only bypass lane until SR 99 merges to two lanes near the WOSCA detour. This transit-only lane would help mitigate the effects of construction on transit travel times. At the north end, most buses enter or exit SR 99 at Denny Way. Transit corridor travel times were assessed to better understand how transit might be affected by SR 99 restrictions. Transit travel times were assessed from Ballard to downtown Seattle along Elliott Avenue and from West Seattle to downtown Seattle. During construction, congestion is expected to increase and result in slower travel speeds on SR 99, resulting in travel time increases ranging from 1 to 3 additional minutes as compared to projected travel times for the 2015 Existing Viaduct.

Increased congestion on First Avenue S. or Fourth Avenue S. during construction could affect transit operations. Additionally, during the 3-week closure of SR 99 or any other night or weekend closures, buses would need to use alternate routes.

How would construction affect ferry traffic?

The Seattle Ferry Terminal at Colman Dock serves the largest number of Washington State Ferries customers of any terminal in the system. The adjacent terminal at Pier 50 is also being used by passenger-only ferry service provided by King County.

Ferry traffic would be affected by the closure of Alaskan Way S. between S. Atlantic Street and S. King Street throughout construction. Vehicles entering the Seattle Ferry Terminal from the south would need to use First Avenue S. to connect to a cross street and access Alaskan Way S. north of S. King Street. Vehicles exiting the Seattle

Ferry Terminal would also need to connect to First Avenue S. or other north-south streets north of S. King Street to travel southbound. North of the Seattle Ferry Terminal, vehicles entering and exiting the ferry terminal would have the same access to Alaskan Way as they do today until the last year of the project when the viaduct would be demolished.

Ferry traffic would be most affected by viaduct demolition activities during the last year of construction. Viaduct demolition would restrict Alaskan Way and require the closure of cross streets located under the viaduct for about 2 weeks. Ferry passengers would need to be informed of street closures that may affect their route to and from the Seattle Ferry Terminal. Many walk-on ferry passengers exit the Seattle Ferry Terminal and Pier 50 using the Marion Street pedestrian bridge, a pedestrian overpass that connects Colman Dock to First Avenue at Marion Street. The bridge would continue to be used until the last year of construction. Viaduct demolition would also remove and ultimately replace this pedestrian bridge because the bridge crosses directly underneath the viaduct's lower deck. During viaduct demolition, a temporary detour would be located at-grade across Alaskan Way S. until the new pedestrian overcrossing is constructed.

As planning and design of the project and construction staging progresses, coordination with Washington State Ferries and King County staff will continue to take place to ensure that disruptions or degradations to access to and from the Seattle Ferry Terminal and Pier 50 are minimized or avoided.

How would event traffic be affected during construction?

People attending major events at the stadiums or Seattle Center would experience additional delays due to temporary lane closures and access modification to SR 99 ramps. The closure of Alaskan Way S. between S. Atlantic and S. King Street would likely increase congestion on First Avenue S. when event traffic is heading to or leaving the stadium area.

Lane restrictions on Mercer Street and Broad Street in construction Stages 2 through 4 and closure of Broad Street in Stage 5 (mid-2013) would cause delays and confusion for some drivers traveling to and from events at the Seattle Center. Signage and signal timing would be critical for maintaining traffic flow and circulation during major events. Periodic closures on John, Thomas, and Harrison Streets and Sixth Avenue N. during the last year of construction for surface street restoration could also cause some delays. Delays on local streets during construction are discussed in Question 15 of this chapter.

How would bicyclists and pedestrians be accommodated during construction?

For safety, bicyclists and pedestrians would be routed around construction zones. During construction, there would be temporary closures of sidewalks and trail facilities for utility relocations, construction, demolition, and street restoration. To maintain bicycle and pedestrian mobility and accessibility, the duration of the temporary closures would be minimized to the extent practical. As part of the traffic management plan, construction mitigation will include accessible routes to accommodate persons with disabilities. The location and duration of temporary closures will be determined by the contractor during final design.

OTHER TEMPORARY CONSTRUCTION EFFECTS

17 How would soil and contaminated materials be handled and removed during construction?

The Bored Tunnel Alternative would excavate soil and material to relocate utilities, construct foundations, build retained cuts and cut-and-cover tunnel sections, and construct the bored tunnel. Excavated materials, particularly near the portals, may be contaminated, which would require special handling and disposal. Exhibit 6-6 shows the estimated volume of excavated material and the amount of that material that may be potentially contaminated. Excavated material would be hauled away by trucks or railcars, or at the south portal area may be conveyed to a barge at Pier 46, the northern edge of Terminal 46. At this time, it is unknown how material

would be removed from the project area; therefore, specific impacts related to materials removal cannot be quantified. Materials would be removed to a predetermined site. Trucks will be required to follow City-designated truck routes and could cause increased congestion and delay on these routes. In the south portal area, the primary route for trucks to haul excavated materials would be the temporary SR 99 off-ramp to S. Atlantic Street to First Avenue S. to SR 519 (Edgar Martinez Drive S.). Routes being considered for hauling excavated material in the north portal area include I-5 to Fairview Avenue N. to Denny Way to Sixth Avenue N. to the construction zone. SR 99 to and from the north is also available as a potential haul route.

Exhibit 6-6
Excavated and Contaminated Soil Volumes
in cubic yards

	South Portal	Bored Tunnel	North Portal	Total
Excavated material	400,000	808,000	210,000	1,418,000
to			to	to
450,000			240,000	1,498,000
Estimated potentially contaminated excavated material	217,400	8,080	96,970	322,450

There are six general types of contamination found in the project area:

- Oil (mid- to heavy-range petroleum hydrocarbons)
- Gasoline
- Metals (such as arsenic, chromium, lead, and mercury)
- Solvents (such as trichloroethylene and tetrachloroethylene)
- Polychlorinated biphenyls (PCBs)
- Polycyclic aromatic hydrocarbons (PAHs) (associated with oil and creosote-treated timbers)

In the south portal area, wood debris could be encountered, including creosote-treated timbers that are a source of PAHs. Fill in the area may also contain petroleum and metals. The contaminants most commonly found in the north portal area are gasoline, petroleum (diesel), and solvents associated with past site uses.

Construction activities would likely result in several types of effects related to hazardous materials:

Appendix P, Earth Discipline Report and Appendix Q, Hazardous Materials Discipline Report

Additional information on the geologic setting, soils, and hazards in the project area is provided in *Appendix P*. Information about contamination that could be encountered during construction is provided in *Appendix Q*.

Appendix Q, Hazardous Materials Discipline Report

Methods used for assessing existing conditions, environmental effects, and mitigation are described in *Appendix Q, Chapter 2*. *Appendix Q* also includes additional information on the subsurface explorations conducted in the project area.

- Spoils containing contaminated soil and debris would be removed.
- Contaminated groundwater would be extracted during dewatering activities.
- Groundwater pathways could be modified due to subsurface construction activities, which could spread groundwater contaminants.
- Air quality near the project area could be affected by the release of contaminants and dust during construction.

The total amount of excavated material is estimated to be 1,418,000 to 1,498,000 cubic yards. The maximum daily volume of soil that would be excavated in the portal areas is estimated to be approximately 2,800 cubic yards, or about 4,000 to 5,000 tons. Spoils from the tunnel would be approximately 3,900 tons per day, assuming the TBM advances 30 feet per day. Waste handlers for problem waste estimate that they accept approximately 5,000 tons of problem waste per day for disposal at a Resource Conservation and Recovery Act (RCRA) Subtitle D landfill (which accepts municipal waste). More than one waste disposal company may be contracted to address the volume of soil requiring off-site disposal. Advanced coordination for disposal would mitigate the spoils disposal issue.

Dewatering would likely be required during construction to control groundwater flow. To the extent feasible, the dewatering systems required for construction would be designed to minimize drawdown of the water table. This would reduce the volume of groundwater that requires treatment and disposal. It would also reduce the potential for groundwater contamination to spread in the project area.

Properties with Contaminated Sites

On the 11 properties and 4 easements that would be acquired to build the Bored Tunnel Alternative, 17 contaminated sites have been identified. Of these

contaminated sites, 6 are located near the south portal, and 11 are located near the north portal. Contamination on most of the 17 sites could have a moderate or high impact on the project. Most of the sites are associated with former railroad operations, metal works, a junkyard, gas stations, and dry cleaners. Seven buildings would be modified or acquired, including one that would be acquired if the Curved Sixth Avenue option is implemented. Two of these buildings may be modified for construction easements, potentially associated with compensation grouting. None of these sites presents an unavoidable adverse effect because WSDOT’s best management practices (BMPs), which are contract requirements, are capable of handling the type of contamination on these properties. Four sites on three properties present a potentially high impact on the project because of potential solvent contamination. High-impact sites can be large, have large volumes of contaminated material, or have a long history of industrial or commercial use where there is a lack of information to predict cleanup costs. Examples of operations that could create high-impact sites include dry cleaners, metal plating facilities, large bulk petroleum facilities, and refineries.² Conducting site investigations in advance of construction when feasible would allow WSDOT to consider risk when developing construction schedules and costs.

The other 13 sites would be moderate- and low-impact sites. These sites are typically small to medium in size, contain potential contaminants that are not extremely toxic or difficult to treat, and can be cleaned up using common cleanup approaches. Examples of the types of operations that can create moderate- or low-impact sites are gas stations, auto repair shops, small manufacturing operations, buildings with materials containing asbestos and/or lead-based paint, and other operations that use aboveground or underground storage tanks.

18 Would settlement during construction affect surrounding areas?

Settlement from tunnel boring could affect nearby surface streets, various utilities (including traffic signals), and buildings under the proposed bored tunnel alignment.

Effects would vary depending on ground conditions, tunnel depth, and other variables. Settlement at the surface is anticipated to be less than an inch over the tunnel for most of the alignment. However, between the south portal and Yesler Way where the TBM would begin boring and be in relatively shallow fill material, settlement could be as much several inches directly over the tunnel. This surface settlement would generally occur incrementally as the TBM advances, with some final settlement occurring over several weeks. Some uneven settlement may cause minor cracks in the pavement and sidewalks above the bored tunnel alignment. Pavement damage would be repaired by temporary overlay. Damage to items on the surface streets, such as trees, manholes, drains, and signals are expected to be minor and would be repaired. The streets and sidewalks would be permanently repaired where needed once construction is completed and no further settlement is occurring.

Where needed, protective measures such as compensation grouting or compaction grouting would be used during tunnel boring to prevent or limit damage to buildings and utilities from settlement. Experience in Europe indicates that these measures control settlement to within 22 millimeters.³ The use of these measures is expected to prevent damage to most buildings. However, two buildings, the Western Building and the Polson Building, may experience settlement that could damage the structures. These buildings are contributing buildings in the Pioneer Square Historic District and are further discussed in Question 24 of this chapter.

19 How would construction affect noise levels?

Noise Overview

Noise during the construction period would be bothersome to nearby residents and businesses because it would make it unpleasant to be outside and hard to hold conversations. Construction could occur up to 24 hours a day, 7 days a week, and noise variances may be required. Construction noise would mostly affect areas adjacent to the south and north portals during the 5.5-year construction period. Construction noise would be

What volume of soil would be excavated for the bored tunnel?

Bored tunnel construction would remove approximately 808,000 cubic yards of material. This volume of material is enough to cover a football field with soil 378 feet deep. As a comparison, the Qwest Field roof is about 200 feet high.

What are validated sites?

Validated sites are categorized as having a “high,” “moderate,” or “low” potential to adversely affect the project, as defined by WSDOT.

Acquired Properties

Locations of the properties that are partially or fully acquired for the Bored Tunnel Alternative are shown in Exhibit 5-39 in Chapter 5.

Appendix F, Noise Discipline Report

Additional information about the effects of noise and vibration during construction is provided in *Appendix F, Chapter 6*.

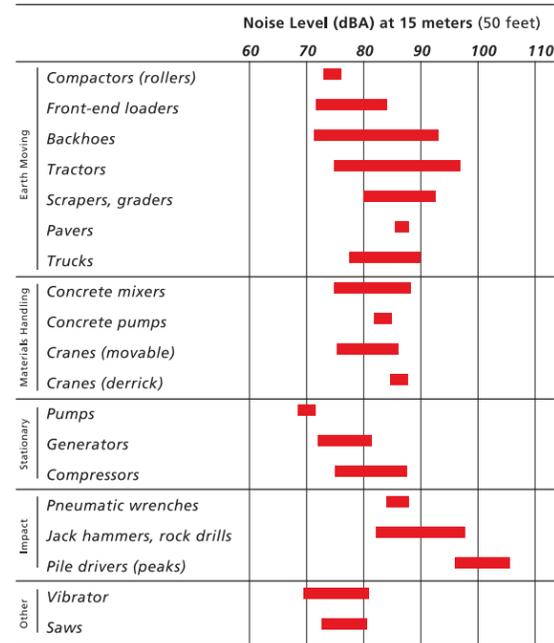
² WSDOT. 2009.

³ Littlejohn. 2009.

intermittent, occurring at different times over the 5.5-year construction period at various locations in the project area. Noise levels would depend on the type, intensity, and location of construction activities.

The most common noise sources during all stages of construction would be machine engines such as bulldozers, cranes, generators, and other earth- and material-moving equipment. Maximum noise levels from construction equipment would range from 69 to 106 A-weighted decibels (dBA) at 50 feet as shown in Exhibit 6-7. In comparison, the project area is currently noisy, with peak hour average daytime sound levels that range from 61 to 80 dBA.

**Exhibit 6-7
Typical Construction Equipment Noise Levels**



Source: EPA 1971 and WSDOT 1991

Because various pieces of equipment would be turned off, idling, or operating at less than full power at any given time and because construction machinery is typically used to complete a short-term task at any given location, average daytime noise levels would be less than the maximum noise levels shown in Exhibit 6-7. The majority of construction activities would fall within the range of about 75 to 95 dBA at 50 feet, with some activities like

impact pile driving reaching levels just over 100 dBA at 50 feet. Pile driving is not currently proposed and would be used only in instances where less disruptive techniques are not available. The only locations where pile driving may be used are for the cut-and-cover sections near the portals. In contrast, the operation of stationary equipment (such as pumps, generators, and compressors) would have sound levels that are fairly constant over time.

Noise Impacts in Specific Areas

Viaduct removal would be the loudest construction activity for residents and employees located near the viaduct between S. King Street and the Battery Street Tunnel. Although viaduct demolition would take approximately 9 months, demolition of individual two-block segments is expected to last no more than 4 weeks. Residents and businesses located along Battery Street may also experience increased noise levels while the Battery Street Tunnel is being decommissioned.

At the south portal staging area on the WOSCA property, noise sources could include large stationary equipment such as temporary operations buildings, a slurry plant, and a concrete batch plant to support the construction of the bored tunnel. Excavation of support walls for the tunnel would also be constructed in the south portal area and on the WOSCA property. Hopper cars or conveyors to move the spoils coming out of the tunnel could be located in this area and contribute to the construction noise. Equipment used for soil improvements would also generate noise.

Construction noise from the TBM operations would occur at the staging areas where the boring would begin and end and the muck and slurry would be treated, stored, and removed. The TBM would also produce some noise that would be heard for a short time in the south portal staging area as tunnel boring begins. However, once the TBM is underground, the noise would not be noticeable due to the depth of the TBM and the typical noise levels along surface streets in the area.

The north portal area would experience noise from construction equipment and activities. Construction to extend Sixth Avenue N. and connect John, Thomas, and Harrison Streets across Aurora Avenue would cause typical surface street construction noise. Excavation and cut-and-cover construction would generate noise associated with earth-moving equipment and materials handling. Noise associated with the dismantling and extraction of the TBM would be similar to that associated with engine-powered construction equipment.

20 Would vibration during construction affect surrounding areas?

Construction activities that would cause the highest levels of vibration are demolition of the viaduct and the use of impact equipment, such as jackhammers and pile drivers. Pile drivers would be used only when other methods will not work. Buildings would be evaluated on a case-by-case basis during final project design to determine what specific mitigation measures are needed to minimize vibration and potential damage to older, fragile buildings.

Viaduct demolition and removal in locations adjacent to existing buildings would use concrete munchers to control the size and dispersion of concrete debris. In other areas, the viaduct could be demolished using various methods of concrete removal. The use of jackhammers and hoe rams would cause the highest levels of vibration during the demolition activities.

The TBM would also produce some ground vibration, but due to the depth of the TBM and the noise levels along the surface streets the vibration levels would not be noticeable at building level and would not pose a damage risk to buildings. The risk of construction vibration damaging underground and buried utilities would generally be less than the risk of damaging buildings. The only proposed construction activity that would generate vibration levels that could damage utilities is impact pile driving. Pile driving would be performed only when other methods will not work. Utilities less than 25 feet and older cast-iron water mains less than 100 feet from impact pile

What is a dBA?

Sound levels are expressed on a logarithmic scale in units called decibels (dB). A-weighted decibels (dBA) are a commonly used frequency that measures sound at levels that people can hear.

A 2-dBA change in noise levels is the smallest change that can be heard by sensitive listeners.

driving locations would be evaluated during final design to determine whether mitigation is needed.

21 How would views be affected during construction?

Views for drivers and pedestrians during construction would include elements common to construction activities, including staging areas, heavy equipment, scaffolding, cranes, trucks, and temporary materials storage. At both the south and north portals, views may also include construction pits and equipment needed to launch and extract the TBM. The south portal is expected to have extensive staging on the WOSCA property for equipment and materials associated with transferring excavated materials to trucks or barges, which may include materials stockpiles and conveyor systems. The WOSCA staging area may also include a slurry separation plant, concrete batch plant, and temporary electrical substation. These elements would be visible from nearby streets.

During viaduct demolition, construction equipment and materials would be prominent in street views and could look similar to the photograph shown in Exhibit 6-8. Normal streetscapes would be disrupted with fencing, equipment, vehicles, and general construction activity. Views under the viaduct would be interrupted by construction equipment and materials.

The visual effects of construction would generally not change the regional views. Where distant views of water features and mountains are present, they likely would remain visible.

22 Would temporary construction easements or relocations be needed during construction?

Temporary easements would be needed for tiebacks and a variety of construction activities. Temporary tieback easements would be needed on the Port of Seattle's Terminal 46 property in the south portal area and four properties in the north portal area. Of the four properties, two are located at Republican Street and Aurora Avenue N., and the other two are located along the Sixth Avenue options.

Temporary construction easements would be needed on 18 properties along the bored tunnel alignment, and 1 property near the north portal area. Fifteen of the properties along the bored tunnel alignment would be between Yesler Way and University Street, and three would be in the vicinity of Denny Way. The property near the north portal would be just south of Thomas Street. Most of these temporary construction easements would be needed to implement settlement mitigation measures, such as grouting. Some of the affected properties are privately owned pay parking lots adjacent to the viaduct. On these properties, some or all of the parking would be removed during the 9-month viaduct demolition period. As a result, businesses and residents that rely on these parking areas may be temporarily inconvenienced.

If any occupants are displaced, they would be compensated and provided relocation assistance in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended, and the Washington Relocation Assistance – Real Property Acquisition Policy Act of 1970, as amended.

23 How would the local and regional economy be affected during construction?

Construction would inconvenience or disturb businesses and customers of businesses adjacent to the project area. Construction-related effects would vary considerably over time and area. Effects can also vary according to the methods used to stage and construct the Bored Tunnel Alternative. Mitigation measures would be in place to minimize or avoid economic impacts, as described in Question 37 in this chapter.

Within the south portal area, 95 businesses have been identified between Alaskan Way S. and Occidental Avenue S. and between S. Royal Brougham Way and S. King Street. Many of these businesses have their primary pedestrian access along First Avenue S., with secondary access on Occidental Avenue S. Within the north portal area, 100 businesses have been identified; many of these businesses provide off-street parking. In total, the design team has identified approximately 1,040 businesses

(including multi-family residential buildings) within one block of the proposed changes to the existing viaduct or the new facility that would experience disruption during construction. These temporary effects could include the following:

- The presence of construction workers, heavy construction equipment, and materials in the construction area.
- Increased traffic congestion around the work zone.
- Temporary road restrictions, traffic diversions, pedestrian detours, and alterations to property access.
- Loss of parking, especially on-street, short-term parking.
- Airborne dust.
- Noise and vibration from construction equipment and vehicles.
- Decreased business visibility and alterations to access.
- Rerouted pedestrian access to primary business entrances.

Up to 157 active commercial and industrial buildings are located within 50 feet of the existing viaduct. Many of these buildings along the waterfront are occupied by multiple businesses. Some businesses in these buildings may suffer little or no adverse effects, while others may experience a noticeable decline in sales, increase in costs, or decrease in efficiency. However, the period of active disruption in front of any one building is estimated to be approximately 2 months, one of which would be for viaduct demolition. Short-term disruptions could be caused by one of or a combination of the following: utility relocations before viaduct demolition; loss of use of loading areas under the viaduct; setup or removal of materials and equipment; and loss of private parking areas under the viaduct. Near the south portal, there are approximately 6,900 off-street parking spaces in major parking facilities near the stadiums and more than 6,000 off-street parking spaces in the Pioneer Square neighborhood. Near the north portal, there are over 7,000 off-street parking spaces located between Denny Way and Roy Street and between about Westlake Avenue N. and Fifth Avenue N. The parking spaces removed during construction are not expected to substantially affect

Appendix D, Visual Quality Discipline Report

Additional information about construction effects on visual quality is provided in *Appendix D*, Chapter 6.

Demolition of an Elevated Roadway Section



PHOTO COURTESY OF KEITH SHERRY – keith@ellisport.com

Exhibit 6-8

Demolition during the first phase of SR 519 project. Photo courtesy of WSDOT.

What is a tieback easement?

A temporary tieback easement allows for temporary use of a property below the surface for a wall shoring system that would be used to build a permanent wall and may be abandoned after the permanent wall is constructed. The tiebacks in the temporary easement areas would be removed or the tension released after construction is completed.

Appendix G, Land Use Discipline Report

All of the properties where temporary tieback easements or construction easements would be needed are indicated in *Appendix G*, Chapter 6. *Appendix G* also provides additional information about construction effects on land uses.

businesses or community services because adequate off-street spaces would still be available in both of the portal areas.

Large events and festivals at Seattle Center that occur during north portal construction would require measures to handle the influx of people attending these events. Measures could include installing signage to direct traffic and limiting traffic restrictions.

Without proper planning and appropriate mitigation, these construction-related effects could adversely affect the comfort and daily life of residents and inconvenience or disrupt the flow of customers, employees, and materials and supplies to and from these businesses. Mitigation measures are discussed in more detail in Questions 37 in this chapter.

Economic Benefits

The capital costs associated with construction of the Bored Tunnel Alternative would result in additional activity throughout all economic sectors within the Puget Sound region and the State of Washington. For every dollar spent on the construction, two dollars of additional economic activity would be generated in the Seattle-Tacoma region, and slightly more than two dollars would be generated statewide. This additional economic activity would occur across all economic and labor sectors. Also, every dollar spent on capital costs translates directly into \$0.61 in new wages and salary earnings for jobs not directly associated with construction. Approximately 8 percent of the total capital cost for the Bored Tunnel Alternative would come from federal funds, which represents new money coming from outside the Puget Sound region to support the local economy.

The estimated average number of jobs directly related to construction of the Bored Tunnel Alternative would be 480 jobs per year, representing about \$64.9 million per year in wages and benefits.

Effects on Parking

During construction Stages 1 through 7, the Bored Tunnel Alternative would affect between 680 and 760 on-street and 50 off-street spaces in the project area, as shown in Exhibits 6-9 and 6-11. In addition, there may be short-term (such as peak period) parking restrictions on some streets near the tunnel portals to accommodate transit or general-purpose traffic during construction. The 680 to 760 on-street spaces would result in the annual loss of approximately \$4.5 million to \$5.0 million in parking revenue for the City of Seattle.

Exhibit 6-9 Construction Parking Effects During Stages 1 Through 7

	O N - S T R E E T S P A C E S			Off-Street Spaces	Total Spaces
	Short-Term	Long-Term	Sub-Total		
South Portal Area	180	50	230	50	280
Central	70 – 150	10	80 – 160	0	80 – 160
North Portal Area	140	230	370	0	370
Total	390 – 470	290	680 – 760	50	730 – 810

Removal of parking spaces during construction generally includes the spaces that would be permanently affected (as described in Chapter 5), plus those spaces that would be needed for construction, staging, or demolition activities. During Stage 8, viaduct demolition would affect up to 750 spaces along the central waterfront area as shown in Exhibit 6-10. Construction during Stage 8 would affect up to 1,400 parking spaces in the whole project area, which includes up to 1,160 on-street and up to 240 off-street spaces. Immediately after viaduct demolition, the City expects to begin work on the Alaskan Way Promenade/Public Space and the new Alaskan Way surface street. Construction of these projects will likely reduce parking availability until the projects are completed in 2018. Additional information about these effects is provided in Chapter 7, Cumulative Effects.

Exhibit 6-10 Construction Parking Effects During Stage 8

	O N - S T R E E T S P A C E S			Off-Street Spaces	Total Spaces
	Short-Term	Long-Term	Sub-Total		
South Portal Area	180	50	230	50	280
Central	540 – 550	10	550 – 560	Up to 190	Up to 750
North Portal Area	140	230	370	0	370
Total	Up to 870	Up to 290	Up to 1,160	Up to 240	Up to 1,400

South Portal Area

In the south portal area, south of S. King Street, about 230 on-street and 50 off-street spaces would be removed during construction. Of the on-street spaces, most are short-term parking, although about 50 long-term spaces would be removed as well. The majority of the on-street parking space removals would be along Railroad Way S. and under the ramps. The 50 off-street spaces that would be affected are located in a public pay lot south of S. Royal Brougham Way, behind the Pyramid Alehouse.

The removal of about 280 parking spaces in the south portal area is not anticipated to substantially affect parking availability in the area, although some drivers may be slightly inconvenienced. The on-street parking removals along First Avenue S. between S. King Street and Railroad Way S. may affect customer parking for adjacent businesses. However, on-street parking would continue to be available a block to the north and along S. King Street.

Although parking would be reduced compared to today’s conditions, ample parking is expected to be available in pay lots near the stadiums. Pay lots in the stadium area are abundant and underutilized on non-event days. The off-street parking utilization rate for the stadium area is about 31 percent on an average non-event weekday,⁴ suggesting that it is relatively easy to find a pay parking space in the stadium area. In addition, most surface streets in the area allow on-street parking, and some of it is long-term, particularly farther south.

During events such as Seahawks, Mariners, and Sounders games, parking is currently highly utilized, and private lots charge a premium for event parking. The removal of about 50 off-street parking spaces is not expected to noticeably affect the overall parking supply. Approximately 6,900 off-street parking spaces are available in the major parking facilities near the stadiums.

Central Waterfront Area

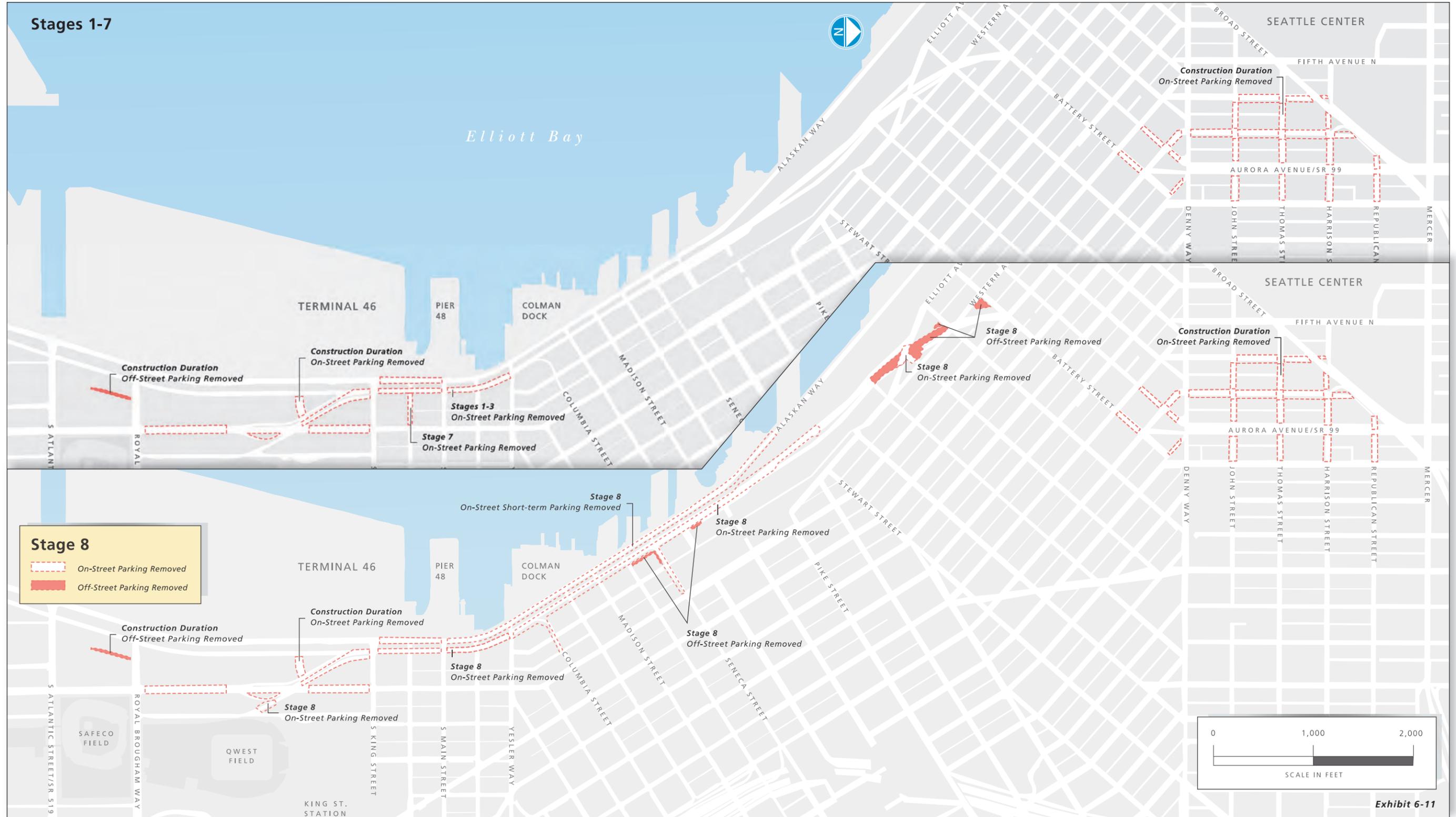
Approximately 80 to 160 on-street parking spaces in the central area would be affected during Stages 1 through 7. Before viaduct demolition, some parking adjacent to the

Appendix L, Economics Discipline Report

Additional information on regional economic activity and project costs is provided in *Appendix L, Section 6.1.1.*

4 PSRC. 2007.

Parking Affected During Construction



viaduct would be affected when utilities on the viaduct are being relocated to nearby areas.

During Stage 8, approximately 550 to 560 on-street parking spaces under the viaduct and ramps and along Alaskan Way would be removed for viaduct demolition. All of these are short-term spaces, with the exception of up to 10 long-term spaces. Of the 550 to 560 on-street spaces, 510 are paid and 40 to 50 are unpaid. Affected off-street parking would range from 140 to 180 spaces during viaduct demolition. In addition to the public parking that would be affected during viaduct demolition, up to about 140 private/business/reserved parking spaces under the viaduct could be affected at the same time. All of these spaces would be removed during viaduct demolition, but they would not be permanently removed by the Bored Tunnel Alternative. Immediately after viaduct demolition, the City of Seattle expects to begin work on the Alaskan Way Promenade/Public Space and new Alaskan Way surface street. The City's construction of the Alaskan Way surface street is expected to affect parking until the project is completed in 2018.

About 50 of the on-street parking spaces are along the Alaskan Way surface street between S. King Street and Pine Street. Although on-street spaces along Alaskan Way are not under the viaduct, they would be affected because demolition activities would likely encroach on Alaskan Way. To maintain traffic lanes, parking would need to be restricted along several blocks of Alaskan Way. The parking on Alaskan Way between S. King Street and Pine Street would be affected at some point during viaduct demolition, but the Bored Tunnel Alternative would not remove all of these spaces at the same time. The current plan is for two demolition crews to each work on two blocks at a time, so four blocks of parking would be affected for approximately 1 month at a time during demolition. Much of the on-street parking along Alaskan Way consists of loading and taxi waiting areas. These types of spaces could likely be accommodated within a block or two of their current locations and would only be relocated for a month or two at a time.

Near Elliott and Western Avenues, up to about 140 off-street spaces in the parking lots under the viaduct between Lenora Street and Bell Street would be removed during demolition of this section of the viaduct. Of the 140 spaces, 75 of them are available to the public only during evening/weekend hours. A small public parking lot on the northeast corner of Battery Street and Western Avenue also would be affected during viaduct demolition and Battery Street Tunnel decommissioning, resulting in a total of 150 affected spaces in this area.

The affected off-street spaces do not include the parking lot in the upland portion of Pier 48 at about S. Main Street, adjacent to Pioneer Square, which may be used for contractor staging or construction worker parking. Although this lot is currently used for some public parking, the public parking is a temporary condition.

In addition to the public parking that would be affected during viaduct demolition, about 140 private and reserved spaces are located under or adjacent to the viaduct that are not listed in Exhibit 6-10. Individual block faces have between 0 and 30 private or reserved spaces along the west side of the buildings/loading docks, with an average of about 15 of these spaces per block. Each block would experience parking removals due to viaduct demolition activities. The private and reserved spaces are primarily used by adjacent businesses for customer and employee parking, and for loading in some cases. Loading zones may be temporarily relocated to adjacent side streets during viaduct demolition.

Parking removals during viaduct demolition would make it more difficult to find parking along the central waterfront and in Pioneer Square during demolition activities. Drivers may need to look for parking spaces several blocks farther from their destinations than they normally would, or use pay lots instead of on-street parking. There are numerous off-street parking lots near the central waterfront.

North Portal Area

In the north portal area, the project would remove about 370 on-street spaces during construction. The removals would be needed to accommodate new transit lanes, construction traffic, utility relocations, and other construction activities. No public pay lots would be affected in this area. Of the affected on-street parking spaces, the majority are long-term spaces, as identified in Exhibit 6-9. The on-street parking removals include spaces on the following streets:

- Sixth Avenue from Wall Street to Broad Street
- John Street from Taylor Avenue N. to Dexter Avenue N.
- Thomas Street from Taylor Avenue N. to Dexter Avenue N.
- Harrison Street from Broad Street to Dexter Avenue N.
- Republican Street from Broad Street to Dexter Avenue N.
- Taylor Avenue N. between John and Harrison Streets
- Wall Street between Fifth Avenue and Denny Way
- Battery Street between Fifth Avenue and Sixth Avenue
- Seventh Avenue between Battery Street and Denny Way

Utility relocations would affect several blocks of parking on John Street and Taylor Avenue N., listed above, for 6 months or less.

Near the north portal, on-street parking would still be available within several blocks of the spaces that would be removed. Numerous off-street lots are also located within several blocks of the removed parking spaces. Over 3,100 pay spaces are available between Denny Way and Roy Street, and Fifth Avenue N. and Dexter Avenue N., according to data obtained from the Puget Sound Regional Council for 2006. The 3,100 spaces take into account parking spaces that have been removed for construction of the Gates Foundation campus and the new Fifth Avenue Parking Garage. There are no anticipated direct effects on access to these garages during project construction. With the removal of 370 parking spaces, there would continue to be nearby parking options; however, it may become slightly more difficult to find

parking on event days, and parking in some lots could potentially become more expensive.

Construction Worker Parking

The number of construction workers is anticipated to be about 500 workers for much of the construction period. It would take a few months at the beginning of construction for the construction workforce to ramp up, and then the number of construction workers would taper off toward the end of construction. The work areas for these construction workers would be in several locations, with concentrations near the south portal, the north portal, and the central waterfront as demolition is occurring. The upland portion of Pier 48 may be used for construction parking. Construction workers who are not able to park within the construction zone may seek available long-term parking in the area, first pursuing on-street spaces and then pay lots away from the work areas. Construction workers would be prohibited from parking on the street or in pay lots near the construction zone.

24 How would historic resources be affected during construction?

The primary construction effects on historic resources would occur from settlement due to soil subsidence as the TBM moves from Alaskan Way S. to First Avenue, moving beneath buildings at the northwest corner of the Pioneer Square Historic District and buildings listed in the National Register of Historic Places (NRHP) to the north of the historic district.

Vulnerable buildings along the bored tunnel alignment may be subjected to damage from ground settlement due to soil subsidence as the TBM bores beneath or close to them. The Bored Tunnel Alternative is being designed to avoid or minimize ground settlement near historic resources. Where needed, improvements such as compensation grouting or compaction grouting would be used to prevent damage to vulnerable buildings and utilities due to ground settlement. Damage that is unavoidable would be mitigated as required.

The anticipated amount of settlement along the alignment is typically small because of mitigation measures in place to minimize settlement. However, two properties that are contributing buildings in the Pioneer Square Historic District may experience settlement that could damage the buildings:

- Western Building – 619 Western Avenue
- Polson Building – 61 Columbia Street

Because of the existing poor structural condition of the Western Building, settlement may cause further extensive structural damage, if unmitigated. Mitigation measures to protect the building may not prevent the need for demolition to avoid the possibility of collapse. The Polson Building may also experience settlement, if unmitigated. However, this building is in good structural condition, and protective measures before construction, along with high levels of monitoring during construction, would prevent major structural damage, and the remaining structural and aesthetic damage could be repaired. These buildings are assessed in more detail in the Section 4(f) Evaluation.

In addition to the Western and Polson Buildings, 12 buildings that are within the Pioneer Square Historic District or listed in the NRHP may be affected by settlement during construction:

- 1 Yesler Building – 1 Yesler Way
- Maritime Building – 911 Western Avenue
- Federal Building – 901 First Avenue
- National Building – 1000 Western Avenue
- Alexis Hotel/Globe Building – 1001 First Avenue
- Arlington South/Beebe Building – 1015 First Avenue
- Arlington North/Hotel Cecil – 1015 First Avenue
- Grand Pacific Hotel – 1115 First Avenue
- Colonial Hotel – 1123 First Avenue
- Two Bells Tavern – 2313 Fourth Avenue
- Fire Station No. 2 – 2334 Fourth Avenue
- Seattle Housing Authority – 120 Sixth Avenue N.

With the exception of the Federal Building, all of these buildings are also Seattle landmarks. These buildings may

experience utility disruptions and cracks or other aesthetic damage from settlement that could be repaired. These repairs would not affect the eligibility of the properties. One additional potentially affected building is a Seattle landmark and is not eligible for listing in the NRHP:

- Watermark/Colman Building – 1107 First Avenue

To limit damage to historic structures, improvements such as compensation grouting or compaction grouting would be used when necessary during tunnel boring to prevent damage to vulnerable buildings and utilities due to ground settlement. It is anticipated that the use of these measures would prevent damage to the vulnerable buildings. In the event that unavoidable damage occurs, it would be mitigated as required and in accordance with the Secretary of the Interior's Standards for Rehabilitation of Historic Buildings (36 CFR 67.7). Additional analysis of these buildings is underway to better refine the extent of potential damage and determine ways to avoid or minimize potential damage.

Buildings above the tunnel alignment may potentially experience effects that would not be adverse, such as utility disruptions, minor cracks that require interior painting or repointing of brick walls, or slightly sticking doors and windows. Although these are not adverse effects, the damage would be repaired in kind, as needed, in keeping with the Secretary of the Interior's Standards (36 CFR 67.7).

In the vicinity of the north portal, there is one historic structure: the NRHP-eligible Seattle Housing Authority building, which is located one block west of SR 99 near Thomas Street. This building would receive compaction grouting to minimize potential damage. Tenants may experience short-term construction effects.

The Alaskan Way Viaduct and the Battery Street Tunnel are an NHRP-eligible structure and would be demolished and decommissioned, respectively, as part of the project with Bored Tunnel Alternative. Viaduct demolition would affect historic buildings on Alaskan Way S. Vibration from

Section 4(f) and Protection of Historic and Archaeological Resources

The project is adjacent to some of Seattle's most well-known historic buildings and neighborhoods. Section 4(f) is a provision of federal law pertaining to transportation projects that requires FHWA to carefully consider and address protection of these resources in order to receive federal funding. Historic and cultural resources that would be subject to use under Section 4(f):

- Alaskan Way Viaduct
- Battery Street Tunnel
- Western Building
- Site 45K1958 – Seattle maintenance yard

In addition, the following historic resources were evaluated for use during construction but were not found to be subject to use:

- Dearborn South Tideland Site
- Polson Building
- 1 Yesler Building
- Maritime Building
- Federal Building
- National Building
- Alexis Hotel/Globe Building
- Arlington South/Beebe Building
- Arlington North/Hotel Cecil
- Grand Pacific Hotel
- Colonial Hotel
- Two Bells Tavern
- Fire Station No. 2
- Seattle Housing Authority

The Section 4(f) Evaluation can be found at the end of this document on page 225. The **Section 4(f) Supplemental Materials** are provided in *Appendix J*.

What is Section 4(f)?

Section 4(f) is a provision of federal law pertaining to transportation projects that requires project proponents to carefully consider protection of park and recreational lands and historic and cultural resources.

The Section 4(f) Evaluation, which is located at the end of this Supplemental Draft EIS on page 225, contains a full discussion of these resources.

demolition could potentially affect older brick buildings adjacent to the structure, primarily those in the Pioneer Square Historic District along Alaskan Way, between S. Jackson and Columbia Streets and near the ramps on Columbia and Seneca Streets. Businesses and residents would experience noise, vibration, reduced access and parking, and traffic congestion. It is anticipated that the period of time during which a particular area would be affected would not be long enough to threaten the maintenance and preservation of the historic buildings. However, the historic neighborhoods (Pioneer Square, the Pike Place Market, and the central waterfront) depend on tourist traffic, so even the perception of reduced access could have notable economic effects. A prolonged construction period could result in the loss of the distinctive character and economic base for historic buildings. However, prolonged construction effects are not anticipated, and the other potential effects associated with the demolition of the Alaskan Way Viaduct would not be considered adverse.

FHWA has consulted with the Washington Department of Archaeological and Historic Preservation, who concurred on July 8, 2010 that the project will have an adverse effect on one or more properties that are on or eligible for the National Register of Historic Places. These properties are the Alaskan Way Viaduct and Battery Street Tunnel, Western Building, Polson Building, and the Dearborn South Tideland site. Any adverse effects would be addressed by a Memorandum of Agreement (MOA) developed in consultation with the State Historic Preservation Officer (SHPO), tribes, and the consulting parties. Mitigation measures, discussed in Question 37 of this chapter, would meet the requirements of Section 106 of the National Historic Preservation Act and other applicable laws, regulations, and policies.

25 Would construction affect archaeological resources?

The primary construction effects on cultural and archaeological resources would likely occur during excavation of the tunnel portal areas, which would disrupt fill and potentially cultural deposits. Construction near the south portal would adversely affect an NRHP-eligible

archaeological site, the Dearborn South Tideland Site (45KI924). It is not feasible to avoid the Dearborn South Tideland Site because it occupies most of the area west of First Avenue between S. Royal Brougham Way and S. Dearborn Street. Avoiding the site would require that the SR 99 corridor to be moved east, which could cause additional impacts on the Pioneer Square Historic District and several historic buildings. FHWA and WSDOT have determined that the site is considered eligible under Section 106 Criterion D for its potential to yield information about early development in Seattle, but its value is in the data that may be recovered and does not depend on its being preserved in place. Section 4(f) regulations provide an exception for the use of these types of archaeological properties (23 Code of Federal Regulations, Title 23, Section 774.13(b) [23 CFR 774.13 (b)]), and the SHPO has concurred with FHWA's finding.

Construction in the south portal area just south of S. King Street may adversely affect Native American and historic-period archaeological deposits that have not been discovered through previous testing. Potential soil improvements from S. King Street to S. Main Street along the bored tunnel alignment may also have the potential to adversely affect Native American archaeological sites associated with the former tidal flats in this location. To avoid potential archaeological deposits, no soil improvements are planned between S. Main Street and S. Washington Street. Soil improvements are also needed in several locations along the bored tunnel alignment between S. Washington Street and Seneca Street, where the soil types are more vulnerable to settlement and the tunnel would be at a relatively shallow depth. Near the surface, excavation of shafts for settlement mitigation, such as compensation grouting, have the potential to intersect Native American archaeological resources. However, soil improvements associated with settlement mitigation between S. Washington Street and Seneca Street would be performed in soil that pre-dates the earliest known human occupation in the area.

Construction in the north portal area may adversely affect Native American and historic-period archaeological sites

from about Harrison Street north beyond the margins of the Denny Regrade. One historic-period archaeological site has been identified in this area, 45KI958 (Seattle maintenance yard). Although this archaeological site has not been formally determined eligible for the NRHP, WSDOT will treat it as eligible under Section 106 Criterion D for planning purposes. Given the constraints imposed by the urban environment and deep historic fill, evaluation and, if necessary, data recovery at this archaeological site would be undertaken in concert with construction. Intact peat deposits, which date to the time of earliest human occupation of the area, also exist in this location. However, no Native American archaeological sites have been identified.

The relocation of utilities along the current alignment of the Alaskan Way Viaduct may also intersect soil layers with the potential to contain Native American and historic-period archaeological resources. However, no such sites have been identified within the areas of ground disturbance.

A historic properties treatment plan would be developed and implemented before the initiation of construction. The plan would detail all measures to evaluate archaeological sites for NRHP eligibility and recover the information that qualifies a site for the NRHP. An Unanticipated Discovery Plan will be prepared for the project that provides for notification and consultation among SHPO, the tribes, and the consulting parties related to discoveries of archaeological material or human remains. All of these measures will be developed in consultation with SHPO, the tribes, and the consulting parties and will be included as part of an MOA to minimize and mitigate adverse effects on historic resources. The MOA will be in place prior to the ROD.

26 How would neighborhoods be affected during construction?

Businesses, government offices, services, and residents would be inconvenienced by the construction traffic detour, congestion, noise and vibration, light and glare, and dust. Construction may be perceived as a temporary

Appendix I, Section 106: Historic, Cultural, and Archaeological Resources Discipline Report

Additional information about construction effects on historic, cultural, and archaeological resources is provided in *Appendix I, Chapter 6*.

barrier to reaching or traveling through a neighborhood. People living or working within approximately two blocks of the construction zone would likely be most affected by construction activities.

An estimated 9,500 housing units and over 15,500 residents live within about two blocks of the project area. On a daily basis, nearby residents may experience the effects of construction-related traffic, noise and vibration, light and glare, and dust. Pedestrian and vehicle use of some streets may be limited. For short periods, direct access to and from some buildings may be disrupted, although not eliminated. During nighttime hours, light and glare would especially affect residents who have direct line-of-sight views to construction zones and staging areas.

27 How would community and social services be affected during construction?

Near the south portal, 13 community or social service providers are located within two blocks of the construction area and would be affected. These include social and employment services, cultural institutions, and government services. Vehicle and transit access to these social resources could be more difficult during the 5.5-year construction period but would be maintained in coordination with the social service providers. Access to buildings may also change for short periods but would be maintained throughout the construction period. These land uses are primarily active during daytime hours when people generally have higher thresholds for loud noises, vibration, light, and glare. Social resources near the south portal are not expected to experience substantial construction effects.

Near the north portal, an estimated 12 social resources are located within approximately two blocks of the construction area. These include four educational institutions, three churches, three social services, a cultural institution, and City of Seattle Parks and Recreation Department offices. All of these resources are generally used during daytime hours. Access to and from these resources would be provided throughout the construction period.

Construction noise could be disruptive to services held by religious organizations in nearby buildings. Disruptions may occur at times when they would not normally be expected. As a result, construction could be perceived to have adverse effects.

Similarly, operators of the two childcare facilities in the north portal area could be concerned about potential disruptions from construction activities. Depending on the hours of operation and the age of the children at the facilities, construction noise could disrupt nap time, and construction noise, dust, or emissions from construction vehicles could disrupt play time for the children.

Adults attending daytime or nighttime classes at Antioch University would experience higher noise levels but would be expected to have higher thresholds for noise.

Removing the existing viaduct, which extends over 20 city blocks, would occur in two 2-block segments at a time. An estimated 22 social resources could be affected by noise, vibration, light, glare, dust, and truck traffic during demolition activities. These include seven childcare or educational facilities, one religious institution, three social services, eight cultural institutions, and three government offices or other facilities. Most of these social resources are visited during daytime or early evening hours, when people have higher thresholds for construction-related disturbances. Vehicle and transit access and access to the buildings are anticipated to be the major concerns of the operators of these social resources.

Eleven social services providers plus dorms for Cornish College of the Arts are located within about two city blocks of the Battery Street Tunnel. Most of the work to decommission (fill) the Battery Street Tunnel would occur underground during the same 9 month period that viaduct demolition is occurring. For a short period, there would also be some disruption on the surface street to inject fill. Vehicle and transit access to and from these community resources, as well as access in and out of the buildings, is not expected to change. As a result, effects

would not be expected for most providers. However, three social service providers could be sensitive to increased noise levels during the decommissioning.

One nonprofit organization, the Seattle Jobs Initiative, serves low-income individuals and has office space in the building that would be acquired near the north portal. This office is used primarily for administration purposes. The organization works directly with low-income individuals out of other locations so this office space could be relocated in the area without a substantial disruption to the low-income individuals. Relocation assistance would be provided in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended, and the Washington Relocation Assistance – Real Property Acquisition Policy Act of 1970, as amended.

28 How would low-income and minority populations be affected during construction?

An estimated 9,500 housing units and over 15,500 residents are located within about two blocks of planned construction areas. Almost 2,050 (21 percent) of the housing units in the project area and 3,650 people (24 percent of the population) may be low-income. The concentration of residents and proportion of low-income individuals differ along the corridor. About 550 housing units, or 1,300 persons, are located within two blocks of the proposed construction activities near the south portal. Due to the large number of subsidized, emergency, and transitional housing in this neighborhood, a disproportionate share, more than 40 percent, of these residents are low-income. The St. Martin de Porres emergency shelter, Compass Center, and the Bread of Life facilities are key emergency housing resources near the south portal.

Construction effects on minority and low-income populations include increased congestion, travel delays, increased response time for emergency services, and decreased parking. If not mitigated, these changes could have an adverse effect on the minority and low-income populations in the project area and the organizations that

Appendix H, Social Discipline Report

Additional information about construction effects on neighborhoods, community, social services, environmental justice, and park and recreational resources is provided in *Appendix H*.

strive to serve them. With the mitigation discussed in Question 37 of this chapter, the project would not have a disproportionately high and adverse effect on low-income or minority populations. These populations and organizations rely heavily on transit services, which could be hampered by traffic congestion. Traffic congestion could also delay access by emergency services and make deliveries to service providers more difficult. Construction activities also may adversely affect people with disabilities. Traffic and sidewalk detours, barricades, and other temporary construction measures could present substantial hurdles for these people. Homeless people may try to climb over or otherwise gain access through fences surrounding the construction zone to return to their habitual nighttime shelter locations, at potential risk to themselves.

As reported by area social service providers, the homeless population is concerned with the loss of parking areas used for car camping and the displacement of campsites under the viaduct. The concerns raised are valid. However, since these encampments are illegal they are ineligible for mitigation.

As part of the effort to forecast possible construction effects on these populations, members of the project team have held individual meetings with social service providers. In addition, the area has a substantial number of small businesses, some of which could be minority-owned. During project meetings, several business owners expressed concern that during construction, actual or perceived traffic congestion could discourage customers from driving to patronize businesses in the project area. The project team will continue to look for ways to avoid or reduce construction-related effects on these populations through careful planning and design, and by providing solutions to construction-related problems when they do occur. Mitigation measures will be developed as described in Question 37.

29 How would parks, recreation, and open space be affected during construction?

Construction could disrupt access to park and recreation facilities in the project area. During construction, use of local streets and sidewalks would be periodically restricted, disrupting access to specific sites. Parking would also be reduced during construction, potentially reducing visits by those who normally drive to the area and use park and recreation facilities.

In the south portal area, traffic congestion may cause some people attending events at Safeco or Qwest Fields to use different routes or different modes of transportation. During construction, the proposed trail connection from the Mountains to Sound Greenway Trail to the waterfront would likely be rerouted. The existing Waterfront Bicycle/Pedestrian Facility would be maintained but rerouted to nearby areas during construction.

In the north portal area, traffic congestion, restrictions, changes in access, and loss of parking could affect people attending events at Seattle Center during construction. Construction noise may disturb users at Denny Park, although the park itself would not be affected.

Viaduct removal would likely occur in two 2-block sections at a time. Access to the existing waterfront promenade and other waterfront facilities would be disrupted near the sections being removed, but access would still be available elsewhere along the central waterfront. Visitors to the Seattle Aquarium would experience these short-term changes in access. Resources adjacent to the viaduct would experience noise and temporary changes in access while it is being demolished. During viaduct demolition, pedestrian and bicycle access would be maintained on the Port Side Pedestrian/Bike Trail adjacent to the Port of Seattle facilities. The Port Side Pedestrian/Bike Trail would extend from S. Atlantic Street to S. King Street and would connect to existing facilities on either end. North of S. King Street, the short segments of the Waterfront Bicycle/Pedestrian Facility adjacent to active viaduct removal would be temporarily closed, but elsewhere the

facility would remain open. Bicyclists would have the option of continuing to use First Avenue S. or using in-street bicycle lanes, sharing the road with vehicles, on Second Avenue or Fourth Avenue.

The pedestrian bridge at Marion Street would be replaced after the viaduct has been demolished, so pedestrian access would need to occur at street level while the replacement bridge is being constructed. The Lenora Street pedestrian bridge would not be altered but would likely be closed for a short time while demolition activities are occurring adjacent to the bridge.

30 How would public services and utilities be affected during construction?

Public Services

During construction, public services could be affected by lane closures and increased traffic congestion and delays on roadways in and around the construction area. Response times for police, fire, and emergency medical aid to locations within and near the construction area would likely increase. Fire and emergency medical services outside the project area also could be affected due to changes in traffic patterns on local roads. Increased travel times could be experienced by other public services, such as solid waste and recycling collection and disposal services, postal services, and school bus routes.

During construction, fire hydrants would need to be relocated. Most of these relocations would occur along surface streets, requiring sidewalk and street curb relocations. Water line relocations during construction could temporarily affect water supplies used for fire suppression.

Utilities

The Bored Tunnel Alternative is being designed to accommodate the utilities currently located in the project area, where feasible. Relocations would be performed according to agency regulations and permits, utility provider requirements, and appropriate best management practices (BMPs). Coordination with utility providers is

Appendix K, Public Services and Utilities Discipline Report

Additional information about construction effects on public services and utilities is provided in *Appendix K*.

ongoing to prepare for emergency repair situations and address potential mitigation.

Underground utility relocations typically involve pavement demolition, excavation, repaving, ground support systems, groundwater control, relocation effects on other localized utilities, dust and noise control requirements, traffic disruptions, and lane or sidewalk closures. Aboveground utility relocations typically include placement of new or temporary poles. Direct effects for all utilities include disruptions of utility service during the cutover from existing to temporary service feeds, and again when the permanent utilities are completed. Utilities along the bored tunnel alignment also could be affected by settlement induced by tunnel boring.

Several major construction activities could cause temporary interruptions for utility service customers within the project area. Removing concrete pavement and installing foundations or other structures are anticipated construction activities that may adversely affect vibration- and settlement-sensitive underground utilities, such as water lines. Cast-iron lead-joint water lines, sewers, and drains could require replacement or joint reinforcement before these construction activities begin. Utilities may be temporarily taken out of service in order to remove them from the excavation area and to connect to the new facilities. These interruptions would be planned in advance. Inadvertent damage to underground utilities could also occur during construction. Although such incidents do not occur frequently, they could temporarily affect services to customers of the affected utility while emergency repairs are being made.

31 How would air quality be affected during construction?

Air quality effects during construction would occur primarily as a result of dust and emissions from construction equipment (such as bulldozers, backhoes, and cranes), diesel-fueled trucks, diesel- and gasoline-fueled generators, and other project-related vehicles such as service trucks.

Dust from construction is associated with demolition, land clearing, ground excavation, grading, cut-and-fill operations, and building structures. The amount of dust in the air due to construction would vary from day to day, depending on the level of activity, specific operations, and soil and weather conditions. Larger dust particles would settle near the source, and fine particles would be dispersed over greater distances from the construction site.

Dust from construction activities could be noticeable if not properly controlled. The project team will develop a fugitive dust control plan. The plan would implement WSDOT’s Memorandum of Understanding with the Puget Sound Clean Air Agency to comply with regulations that require dust control during construction and to prevent deposition of mud on paved streets.

In addition, heavy trucks and construction equipment powered by gasoline and diesel engines would generate particulate matter less than 2.5 micrometers in size (also known as PM_{2.5}), carbon monoxide, and nitrogen oxides in exhaust emissions. Traffic restrictions during construction are expected to increase congestion and reduce the speed of other vehicles in the area, which would temporarily increase emissions from traffic while those vehicles are delayed. These emissions would be temporary and limited to the immediate area where congestion is occurring.

Some construction phases (particularly those involving paving operations using asphalt) would result in short-term odors. These odors might be detectable to some people near the site and would be diluted as distance from the site increases.

Because the total construction period would be longer than 60 months, analysis was conducted to determine whether the project conforms to carbon monoxide standards for the worst-case long-term construction period. The results indicate that carbon monoxide concentrations during construction would conform to the National Ambient Air Quality Standards.

32 How would greenhouse gas emissions be affected during construction?

Based on energy consumption related to construction, the estimate of total greenhouse gas emissions (reported as carbon dioxide equivalents, or CO₂e) during the 5.5-year construction period is 48,875 metric tons. For the Bored Tunnel Alternative, annual CO₂e emissions during construction were estimated to be 8,146 metric tons, and the daily emissions were estimated to be 27 metric tons. The 27 metric tons that would be produced by the Bored Tunnel Alternative construction each day is a negligible portion of the total regional emissions of CO₂e under existing conditions and projected for the 2015 Existing Viaduct, as shown in Exhibit 6-12.

Exhibit 6-12 Daily CO₂e Emissions Estimates

	Metric Tons per Day
Bored Tunnel Alternative Construction	27
Existing Conditions – Regional	39,189
2015 Existing Viaduct – Regional	46,557

Construction equipment that contributes to greenhouse gas emissions includes diesel- and gasoline-powered equipment and trucks. Construction areas, staging areas, and material transfer sites would be set up in a way that reduces standing wait times for equipment, engine idling, and the need to block the movement of other activities on the site. These strategies would reduce fuel consumption by reducing wait times and ensuring that construction equipment operates efficiently. Because of space constraints at the work site and the benefit of additional emissions reductions, ridesharing and other commute trip reduction efforts may be promoted for employees working on the project.

33 How much energy would be needed to construct the Bored Tunnel Alternative?

Energy would be needed for the following activities:

- Excavation and grading.
- Material and debris handling and transport.

Appendix M, Air Discipline Report

Additional information on air quality during construction is provided in *Appendix M*.

What are CO₂ equivalents?

Greenhouse gases have different abilities to trap heat. To compare different greenhouse gases, scientists use a weighting factor. CO₂ is used as the standard. Other gases are converted into CO₂ equivalents using the weighting factor.

Appendix R, Energy Discipline Report

Additional information on energy consumption and greenhouse gases during construction is provided in *Appendix R*.

What is a British thermal unit?

A British thermal unit (BTU) is the approximate amount of energy needed to heat 1 pound of water 1 degree Fahrenheit.

- Operation of diesel- and gasoline-powered construction equipment.
- Operation of diesel trucks involved in the transport of excavated material and delivery of construction material, both within construction areas and on local streets. Additionally, the transport of construction material and excavated materials via barge is likely, particularly for spoils excavated from the bored tunnel.
- Operation of the TBM (electric-powered).

The energy required for each construction area was estimated based on horsepower requirements, equipment usage, equipment load factors, and construction schedule. The construction energy requirements of the Bored Tunnel Alternative are provided in Exhibit 6-13. Activities such as interior tunnel construction and operation of the slurry treatment plant (if needed) are included in Exhibit 6-13. The current daily energy consumption by vehicles in the city center is 13,221 million British thermal units (BTUs). The daily energy consumed during construction would be about 114 million BTUs, which is just a small percentage of the overall energy consumption in the region.

A substation would be built in the WOSCA staging area to supply power for the TBM, interior tunnel construction activities, the slurry treatment plant (if needed), and Intelligent Transportation Systems (ITS) signage. Existing electrical service would not be affected by activities powered by the substation.

Exhibit 6-13
Construction Energy Consumption
in million BTUs

	Energy Consumed
South Portal	27,178
Bored Tunnel	176,364
North Portal	30,745
Viaduct Removal & Battery Street Tunnel Decommissioning	14,985
Total	249,271
Total Annual Average*	41,545
Total Daily Average	114

* Annual average based on 66-month construction duration.
BTU: British thermal unit

34 How would water resources be affected during construction?

Construction-related effects of the Bored Tunnel Alternative would be temporary and would be minimized or prevented through proper selection and implementation of BMPs. Construction effects on surface water could occur due to construction staging, material transport, earthwork, stockpiling, storm drainage utility work, and dewatering. Construction-related pollutants such as sediment, oil, and grease can increase turbidity and affect other water quality parameters, such as the amount of available oxygen in the water. In addition, pH can be altered if runoff comes in contact with curing concrete or bentonite drilling slurry, which could have serious effects on aquatic species.

The most likely construction-related water quality effects from staging areas would come from erosion of disturbed soil areas or soil stockpiles, which could result in stormwater runoff carrying silt and sediment to receiving waters. Stormwater runoff may also carry other contaminants, such as fuel or oil from construction operations that might spill during the refueling or servicing of equipment. Although the risk of spills during construction is highest at staging areas, it is a concern in all construction areas. Also, many of the staging areas for the Bored Tunnel Alternative are adjacent to Elliott Bay and the East Duwamish Waterway. The potential for affecting water quality as a result of sediment transport and spills is greater in these locations.

Sediment and other contaminants could also fall onto roadways and be captured in stormwater runoff along haul routes, that is, routes along which construction materials and excavation spoils are transported to and from staging areas and between the construction sites. In addition, because many of the construction materials and excavation spoils may be transported over water by barge, there is an increased risk of water quality effects on Elliott Bay during material transfer from the staging areas.

Dewatering would be required during construction of the south portal cut-and-cover tunnels and most of the

retained cut sections, and it would likely continue until construction of the south portal retaining walls is completed. Dewatering during construction could result in groundwater flow from adjacent areas being drawn toward excavated areas. If this adjacent water contains contaminants, these contaminants could migrate and increase pollutant concentrations in dewatering water.

Construction-related runoff and dewatering water would likely be discharged to the combined sewer system for treatment at the West Point wastewater treatment plant. Before discharge to the combined sewer, stormwater runoff from active construction areas would need to be treated as necessary to comply with applicable permit requirements and project specifications. If any contaminated water is found, it would have to be treated to conform to King County and City of Seattle standards in order to be discharged to the combined sewer system and flow into Elliott Bay or Lake Union at an existing outfall, or it would have to be disposed of off-site at an appropriate hazardous waste facility. Monitoring would be performed in accordance with applicable standards.

Given the rates of pumping for dewatering water in some areas, detention may be needed to avoid overwhelming existing conveyance systems. Depending on the volumes and timing, off-site disposal may be required. Large amounts of dewatering can also increase the risk for ground settlement. This would be mitigated by reinjecting water from the dewatering operation back into the ground. Excess water that is not used for injection would need to be treated and disposed of in the sanitary sewer or at an off-site location.

To the extent feasible, the construction dewatering systems would be designed to minimize reductions in the water table. This would reduce the volume of groundwater that requires treatment and disposal. It would also reduce the potential for mobilization and spreading of groundwater contaminants in the project area. In addition, ground treatment techniques such as freezing may also reduce the need for dewatering. However, adequate site investigation

Appendix O, Surface Water Discipline Report

Additional information about construction effects on water resources is provided in *Appendix O*.

would be necessary to select and design the best ground treatment approaches.

35 How would fish, aquatic, and wildlife species and habitat be affected during construction?

Construction effects on fish, wildlife, and vegetation in the project area would most likely be associated with construction noise and potential temporary and localized sedimentation and turbidity in Elliott Bay. Increased turbidity could occur due to erosion; spoils handling, stockpiling, and dewatering; and potential spills. Potential effects would be avoided, minimized, and mitigated by implementing appropriate BMPs.

Construction materials staging and storage areas near the shoreline could include Terminals 25 and 106. The upland portion of Pier 48 may be used for contractor parking. While most deliveries and construction material transport would be land-based, some materials may be transported by water. These activities would likely occur at Pier 46 at the northern edge of Terminal 46 to support construction activities for both the south portal and the bored tunnel. The use of Pier 46 would not require new overwater structures or in-water construction activities. Barge movement at this location would be similar to existing navigation movements along the shoreline and would not represent a new or different effect. The number of barges would be insignificant in the context of Elliott Bay shipping activities. There are no eelgrass beds in the areas where barge moorage would occur, and shallow draft barges or existing loading facilities would prevent the grounding of barges in the subtidal or intertidal habitat.

36 Would construction have indirect effects?

An indirect effect is a reasonably foreseeable effect that may be caused by a project but would occur in the future or outside of the project area. Construction of the Bored Tunnel Alternative would primarily have direct effects on local and regional traffic during construction. As people adjust their travel patterns during construction, there may be indirect effects as people may change where they shop, where they eat out, or what services they use. These changes could benefit businesses outside of the project

area during construction, but these effects would not be significant.

CONSTRUCTION MITIGATION

37 What construction mitigation plans and measures are proposed for this project?

This Supplemental Draft EIS presents potential measures that could be used to mitigate negative project effects of the Bored Tunnel Alternative during construction. After reviewing public, tribe, and agency comments on this Supplemental Draft EIS, as well as the 2004 Draft EIS and the 2006 Supplemental Draft EIS, the project team will develop more specific mitigation measures to address identified construction effects. Opportunities for public, tribe, and agency review of many mitigation elements will be provided. The project will finalize the list of mitigation measures and commit to their implementation in the Final EIS and the ROD issued by FHWA.

Mitigation measures and plans will be developed by considering effects on adjacent and nearby properties in terms of intensity and duration. Mitigation measures and plans will be tailored to the various construction stages and varying effects as appropriate. The following paragraphs discuss the proposed mitigation plans in more detail.

Transportation

WSDOT will be required to prepare a traffic management plan that must be accepted by the City of Seattle. The plan will ensure that construction effects on local streets, property owners, and businesses are minimized. The traffic management plan will include the following components:

- Descriptions of traffic phasing plans.
- Provisions to maintain existing access to all properties.

- Provisions for maintaining continuous access to established truck routes, hazardous material routes, transit routes, and school bus routes.

- Procedures to identify and incorporate the needs of transit operators, utility owners, ferry traffic, event traffic, Port of Seattle traffic, and business owners in the area.

- Procedures to identify and incorporate measures to facilitate pedestrian and bicycle flow, including mitigation for sidewalk closures and requirements related to the Americans with Disabilities Act (ADA).

- Procedures to identify and incorporate the needs of emergency service providers, the fire department, law enforcement entities, and other related corridor users, as well as procedures to ensure that all information required by these agencies to protect the public is made available.

- Descriptions of contact methods and personnel available 24 hours a day to make decisions and ensure that issues are addressed in a timely and appropriate manner.

- Procedures to communicate construction traffic plans to the public.

- Procedures to accommodate adjacent projects' plans to maintain traffic flow, if applicable.

- Identification of haul routes.

Soil and Contaminated Materials

Temporary erosion and sediment control plans would be prepared for approval in accordance with BMPs included in the current City of Seattle Stormwater, Grading, and Drainage Control Code (Ordinance 119965) and the WSDOT Highway Runoff Manual. Construction BMPs would include barrier berms, filter fabric fences, temporary sediment detention basins, and slope coverings to contain sediment on site. These BMPs would be

Appendix N, Wildlife, Fish, and Vegetation Discipline Report

Additional information about construction effects on wildlife, fish, and vegetation is provided in *Appendix N*.

Transportation Improvements to Minimize Traffic Effects During Construction

In addition to the traffic mitigation measures discussed in **Question 37** in this chapter, WSDOT, King County, and the City of Seattle have developed Transportation Improvements to Minimize Traffic Effects During Construction to keep people and goods moving during construction of the Alaskan Way Viaduct and Seawall Replacement Program (the Program). These specific improvements are discussed in **Chapter 7, Question 17**.

Appendix Q, Hazardous Materials Discipline Report

Additional information on hazardous materials handling and disposal is provided in *Appendix Q, Section 6.5*.

effective in protecting water resources and reducing soil erosion from the construction areas. Erosion control measures suitable to the site conditions would be included as part of the design. Stockpiles should be covered when not in use to prevent erosion from surface water and rain.

Additional investigations to determine whether contamination or other hazardous materials are present at a site are standard mitigation measures. These investigations may include environmental site assessments, an asbestos survey, a lead survey, and a geophysical survey.

Contamination will be encountered. If soil contains more than 5 percent wood debris, it would need to be transported to a solid waste landfill that is permitted to accept wood debris, including creosote-treated piles. Soils that are considered hazardous waste will require appropriate handling and disposal according to the type and concentration of contaminants. Before construction, coordinating with waste disposal companies to prepare for the disposal of contaminated materials would mitigate the issue.

Measures relating to soils and contaminated materials would also be included in the development of mitigation measures for effects on water quality and air quality.

Noise

Daytime construction noise will meet the City of Seattle noise ordinance. Construction of the Bored Tunnel Alternative would also require nighttime construction activities at the portals, including excavation of the TBM assembly pit, construction of cut-and-cover portions of the structure, and construction of the tunnel operations buildings. Therefore, a nighttime noise variance would be required from the City. Because of the magnitude of the project, a Major Public Project Construction Noise Variance would most likely be required. Mitigation requirements for construction noise would be developed in coordination with the City and specified in the noise variance. The mitigation requirements would be implemented by WSDOT. To reduce construction noise at nearby receptors, mitigation measures could be

incorporated into construction plans, specifications, and variance requirements. Possible mitigation measures include the following:

- Develop a construction noise management and monitoring plan that establishes specific noise levels that may not be exceeded for various activities during specific times. This would establish a set of noise limits that could be met during construction while still protecting the public from excessive noise effects.
- Crush and recycle concrete off site, away from noise-sensitive uses.
- Construct temporary noise barriers or curtains around stationary equipment and long-term work areas located close to residences. This could reduce equipment noise by 5 to 10 dBA.
- Limit the noisiest construction activities to between 7:00 a.m. and 10:00 p.m. on weekdays and between 9:00 a.m. and 10:00 p.m. on weekends and holidays to reduce construction noise levels during sensitive nighttime hours.

Mitigation for nighttime construction noise would be developed in coordination with the City of Seattle's noise variance process and specified in the noise management and mitigation plan. WSDOT will prepare a draft noise variance application that will contain specific mitigation measures. The draft application will then go through a public input and review process. WSDOT will revise the application based on this input and formally submit the application to the City of Seattle. The mitigation measures will be included in the ROD.

Vibration

Pile driving, if necessary, would be the main source of vibration during construction. Potential measures to reduce vibration impacts from pile driving could include using other methods such as jetting, predrilling, and pile

cushioning, or other types of piles such as cast-in-place or auger piles.

Vibration from other construction and demolition activities could be reduced by restricting operation to a distance away from historic structures or using alternative construction equipment or methods. Vibration monitoring will be required at the nearest historic structure or sensitive receiver (such as sensitive utilities) within 300 feet of construction activities. The monitored data will be compared to the project's vibration criteria to ensure that ground vibration levels are not exceeding the damage risk criteria for historic and non-historic buildings and sensitive utilities.

Views

Construction mitigation for views is generally limited. The most effective construction mitigation is to restore the areas where construction has been completed in intermediate stages rather than waiting until the entire project is completed.

Relocations

Acquisitions and relocations would occur before construction. Where acquisitions and relocation are unavoidable, WSDOT will follow the provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended. Owners of private property have federal and state constitutional guarantees that their property will not be taken or damaged for public use unless they first receive just compensation.

Temporary easement areas for tiebacks would also be needed for construction and would be removed after construction. These property owners would be given advance notice of disruptions, and construction traffic, dust, and noise would be mitigated to the extent possible.

Property owners on adjacent parcels will be given advance notice of when demolition and construction activities, utility disruptions, and lane restrictions are expected. Temporary access will be provided to local parcels during

Appendix F, Noise Discipline Report

Additional measures to mitigate noise are described in *Appendix F, Section 6.2*.

Detailed descriptions of measures to reduce vibration impacts are provided in *Appendix F, Section 6.2*.

construction activities. Impacts to business will be mitigated as required by the Uniform Relocation Assistance and Real Property Acquisition Policies Act.

Businesses and Economics

Possible mitigation measures for effects on businesses include the following:

- Create a business assistance program that will provide a single point of contact and ensure that businesses have access to project staff.
- Minimize obstructions and maintain access during important business seasons, or minimize the duration of modified or lost access.
- Provide pedestrian detour signage along affected sidewalks.

These mitigation measures are intended to counteract the diminished quality of the business environment for businesses adjacent to construction zones. These measures are not intended to guarantee business success or survival but are intended to maintain access and the setting for businesses and potential customers.

Mitigation plans for transportation would also be important to mitigate effects on businesses and the economy. WSDOT and the City will coordinate with surrounding businesses to develop mitigation strategies, develop parking strategies, create a business assistance program, and develop a construction worker parking plan. Additional potential mitigation measures for businesses during construction would be related to communicating information, maintaining pedestrian access, maintaining habitability, and other factors.

Pedestrian Access

To support pedestrian access to businesses during construction, the following mitigation measures for potential effects on pedestrian access may be applied during viaduct demolition:

- Provide obvious and relatively consistent east-west pedestrian routes from First Avenue to Pier 52 (Colman Dock), Piers 55/56 (Argosy), and Pier 59 (Seattle Aquarium). Primary pedestrian routes would have signage, directional arrows, lighting, and other amenities. All pedestrian routes would provide safe and clean access through the construction zones.
- Provide signage for pedestrians along First Avenue between S. King Street and Bell Street, showing routes and distances (in blocks) to the waterfront. These signs would be updated as the project advances during viaduct removal.
- Provide east-west pedestrian access from Western Avenue to the Alaskan Way piers (Yesler Way to Pine Street) at least every other block during viaduct demolition.
- Provide pedestrian and parking maps in advance of and during construction for businesses (at no cost to the businesses) to mail to clients and vendors.

As the beginning of construction approaches, mitigation measures will be refined to address specific effects on businesses and pedestrian access to businesses. The project will comply with the requirements of ADA.

Parking

Parking mitigation strategies during construction would be coordinated by WSDOT and the City, with input from surrounding businesses. These strategies may include the following:

- Encourage privately held parking lots to institute measures that reward short-term parking.
- Provide short-term parking (off-street), especially serving retail and commercial areas.
- Partner with private and public parking facilities to implement e-Park, an electronic guidance system

displaying real-time parking availability on right-of-way signs, facility signs, and the Seattle Parking Map website. Dynamic message signs would be located on key access points to the downtown, Pioneer Square and the central waterfront.

- Launch the Seattle Parking Map, featuring on-street parking regulations and off-street parking locations, hours of operations, and short-term parking rates.

The following strategies could help minimize the use of visitor/customer parking by construction workers:

- Develop a parking plan for construction workers to identify appropriate parking options for construction workers and discourage use of short-term visitor/customer parking.
- Provide strong enforcement of short-term parking regulations in the immediate project area (two- to three-block radius).

Mitigation for construction effects on any disabled parking spaces will comply with ADA requirements, and accessible replacement parking spaces will be provided.

Section 106: Historic, Cultural, and Archaeological Resources

Section 106 of the National Historic Preservation Act requires agencies to consider the effects of federal actions on historic and cultural resources. Adverse effects on historic and cultural resources that are determined eligible for listing in the NRHP would be minimized and mitigated by means of a MOA developed in consultation with SHPO, the tribes, and the consulting parties.

Historic Structures

All mitigation work undertaken on historic structures would be performed in compliance with the Secretary of the Interior's Standards for Rehabilitation of Historic Buildings (36 CFR 67.7). A range of mitigation measures would be considered for each potentially affected building,

Appendix L, Economics Discipline Report

Additional mitigation measures for businesses are described in *Appendix L, Section 6.4*.

Appendix C, Transportation Discipline Report

Additional parking mitigation strategies are discussed in *Appendix C, Section 7.3.4*.

Appendix I, Section 106: Historic, Cultural, and Archaeological Resources Discipline Report

Additional measures to minimize effects on historic properties, as well as mitigation for the Dearborn South Tideland Site and other potential archaeological and cultural resources, are discussed in *Appendix I, Section 6.2*.

based on its current structural condition, its proximity to the tunnel alignment, and potential damage. Repair of minor damage such as minor architectural cracking, sticking windows and doors, etc. would likely be performed after the tunnel boring operation is completed and the damage appears. Preconstruction mitigation could include strengthening foundations and/or a minor structural retrofit.

A number of measures will be implemented to minimize effects on historic properties, particularly effects from vibration and settlement. These could include the following:

- Implement a monitoring program to provide early warning when building settlement thresholds may be exceeded.
- Specify requirements for the TBM design and operation.
- Use various soil improvement and grouting techniques to improve soil strength, fill voids, or compensate for settlement (Exhibit 6-14).
- Undertake structural strengthening, including strengthening existing building foundations and/or structural retrofit.
- Repair minor damage such as minor architectural cracking or sticking windows and doors.

Settlement monitoring will be a key element of the minimization strategy. Based on the allowable settlement threshold determined in the building assessment, settlement at points on each building would be continuously measured for a period of 1 to 6 months before tunneling reaches the subject building until up to a year after the tunneling operation has passed the building. As the TBM advances, measurement of ground loss directly over the tunnel would provide an indicator of potential effects on buildings and other facilities. If settlement is detected, action would be taken to reduce



the settlement by filling voids with grout created by the tunneling process.

Historic structures could also experience effects from noise, dust and mud, traffic congestion, construction traffic, loss of parking, and limited access during construction. Potential mitigation measures for these effects are described elsewhere in this section (Question 37).

FHWA and WSDOT will closely coordinate mitigation measures with SHPO, the tribes, and the consulting parties. These mitigation approaches would then be the basis for

discussion leading to an MOA to ensure that historic structures are adequately protected during construction.

Archaeological Resources

FHWA and WSDOT will continue to consult with SHPO, the tribes, and the consulting parties to develop mitigation measures for effects on archaeological resources. Depending on the type of resource, mitigating adverse construction effects can involve documentation, excavation, and/or monitoring. Other appropriate measures will be developed on a case-by-case basis with SHPO, the tribes, and the consulting parties. When the parties agree on how the adverse effects will be minimized

Exhibit 6-14

and mitigated, an MOA will be signed and implemented. This agreement will outline mitigation measures, identify responsible parties, and bind the signatories. As a commitment within the MOA and in continuing consultation with SHPO, the tribes, and the consulting parties, the lead agencies will also develop a historic properties treatment plan for archaeological resources that will include a monitoring plan and an Unanticipated Discovery Plan. The Unanticipated Discovery Plan will provide for notification and consultation between FHWA, WSDOT, SHPO, the tribes, and the consulting parties related to discoveries of unanticipated archaeological material or human remains. The Section 106 documentation will be included in the Final EIS.

Neighborhoods and Community Services

Mitigation for effects on neighborhoods and community and social services could include the following:

- Minimize construction-related effects like noise, dust, light, and glare, especially from nighttime work.
- Coordinate with community and social services to ensure that access is maintained and to identify concerns and solutions.
- Establish a neighborhood advisory group prior to construction. Periodically during construction, meet with neighborhood representatives to communicate important information concerning construction activities and to inquire about the effectiveness of the mitigation measures.
- Communicate with neighborhood groups, residents, and providers and patrons of community and social services to ensure that they understand the extent of construction, construction scheduling, how to navigate around construction sites, and what services are offered to them as part of construction mitigation.
- Coordinate with providers of mental health, psychiatric, and drug and alcohol treatment

facilities to determine whether additional special mitigation is needed.

- Provide a 24-hour project hotline for people to call with construction concerns or to obtain information about the project.

Environmental Justice

Although construction would affect minority and low-income populations, effects can be avoided, minimized, and mitigated. Mitigation could include the following:

- Identify and provide information on a safe pedestrian route between Pioneer Square/downtown and the St. Martin de Porres shelter to allow movement of people to and from the shelter throughout construction.
- Work with The Compass Center, Heritage House, Bread of Life Mission, Pike Market Senior Center, Plymouth Housing Group, Catholic Seamen’s Club, and Rose of Lima House to identify concerns and solutions for potential access, parking, air quality, and noise effects.
- Ensure continuous access to buildings, properties, and loading areas used by social service providers during construction.
- Hold briefings and planning sessions with social service providers to keep them up-to-date on the project and to monitor mitigation strategies for minority and low-income populations.
- Cooperate with social service providers on emergent issues that affect minority and low-income populations.
- Secure construction sites to prevent entry and injuries (especially by homeless persons)

Parks and Recreation

Mitigation for park and recreation resources could include the following measures:

- Install signs near affected construction zones, indicating access routes to parks and recreational facilities.
- Coordinate regularly with park and recreation facility operators to ensure that changes in project activities and associated changes in access points and corridors are known in advance.
- If pedestrian bridges, trails, or other pathways need to be closed temporarily, locate replacement pathways within a reasonable distance from the current facility that are ADA compliant and accessible to persons with disabilities.

Public Services

The project will coordinate with the City of Seattle and Port of Seattle police and fire departments, regional transportation agencies, and other appropriate agencies during preliminary and final design. This coordination will develop reliable emergency access and alternative plans or routes to avoid delays in response times and to ensure that general emergency management services are not compromised.

Utilities

The project team will prepare a consolidated utility monitoring, protect-in-place, and relocation plan to address existing, temporary, and new locations for utilities; sequence and coordinate schedules for utility work; and describe service disruptions. This plan would need to be reviewed and approved by the affected utility providers before construction begins to reduce effects.

Air Quality and Energy

A Memorandum of Understanding between WSDOT and the Puget Sound Clean Air Agency is in place to help eliminate, confine, or reduce construction-related emissions for WSDOT projects. WSDOT will create a plan

Appendix H, Social Discipline Report

Additional mitigation measures for neighborhoods, community and social services, and environmental justice are identified in *Appendix H, Section 6.2*.

Additional information about mitigation of temporary effects on parks and recreation resources is provided in *Appendix H, Section 6.2*.

Appendix K, Public Services and Utilities Discipline Report

Additional mitigation measures for public services and utilities are identified in *Appendix K, Section 6.2*.

Appendix M, Air Discipline Report

Other possible measures for reducing emissions of air pollutants near construction areas are described in *Appendix M*.

Appendix R, Energy Discipline Report

Additional energy-saving strategies are described in *Appendix R, Section 6.2*. *Appendix R* also provides additional information about greenhouse gas emissions.

for controlling fugitive dust during construction. The fugitive dust control plan would reduce air pollutant emissions near the construction site, including near residences located along Battery Street adjacent to the open grates.

The project's traffic management plan would help reduce effects on air quality because it would help move traffic through the area to the extent possible. Construction areas, staging areas, and material transfer sites would be set up in a way that reduces standing wait times for equipment, engine idling, and the need to block the movement of other activities on the site. These strategies would reduce fuel consumption and minimize emissions by reducing wait times and ensuring that construction equipment operates efficiently. Due to space constraints at the work site and the benefit of additional emissions reductions, ridesharing and other commute trip reduction efforts may be promoted for employees working on the project. These strategies would reduce both energy consumption and air pollutant emissions. By reducing energy consumption, greenhouse gas emissions would also be reduced.

Greenhouse Gases

Construction mitigation to help minimize congestion, which contributes to greenhouse gas emissions, would be covered in the traffic management plan. The traffic management plan would include traffic routing and strategic construction timing (like nighttime work) to continue moving traffic through the area and reduce backups for the traveling public to the extent possible. WSDOT will seek to set up active construction areas, staging areas, and material transfer sites in a way that reduces standing wait times for equipment. WSDOT will work with its partners to promote ridesharing and other commute trip reduction efforts for employees working on the project.

Water Quality and Fish and Aquatic Resources

Construction effects to surface water would be avoided, minimized, and mitigated through the development and implementation of water quality management plans.

Specifically, the project would likely develop the following plans:

- **Construction Stormwater Pollution Prevention Plan** – This plan would describe BMPs; specify methods for handling dewatering water; discuss fugitive dust control; outline flow control; address detention requirements and protocols to meet requirements and maintain the capacity of the existing conveyance system; describe temporary water quality treatment; specify storm drain protection, maintenance, and monitoring; provide a List of Certified Erosion and Sediment Control Leads who would manage BMPs; and outline requirements for water quality monitoring.
- **Temporary Erosion and Sediment Control Plan** – This plan would outline the design and construction specifications for BMPs to be used to identify, reduce, eliminate, or prevent sediment and erosion problems.
- **Spill Prevention, Control and Countermeasures Plan** – This plan would outline spill prevention, inspection protocols, equipment requirements, material containment measures, and spill response procedures.
- **Concrete Containment and Disposal Plan** – This plan would outline how concrete would be managed, contained, and disposed of. It would also discuss BMPs that would be used to reduce high pH.

Monitoring would be performed in accordance with applicable standards.

Potentially contaminated spoils will be tested and disposed of at appropriate upland facilities by implementing the Construction Stormwater Pollution Prevention Plan; Temporary Erosion and Sediment Control Plan; the Spill Prevention, Control and Countermeasures Plan; and the Concrete Containment and Disposal Plan. Stormwater runoff from active construction sites would be treated

before being discharged into the combined sewer system as necessary to comply with the requirements of the King County discharge permit. Measures to control pollutants will also serve to protect fish and aquatic resources.

38 How will the lead agencies involve people in mitigation planning and implementation?

The lead agencies will coordinate with businesses, agencies, tribes, neighborhood groups, service providers, and others to identify and address concerns as the project design progresses. The lead agencies will continue to hold community briefings and meet with local businesses and service providers to address construction concerns. The lead agencies will work directly with those who are likely to be affected by bored tunnel construction on mitigation strategies to minimize effects. Mitigation measures will be refined and discussed in the Final EIS, and additional or more specific mitigation measures will be developed as needed.

39 What temporary construction effects will not be mitigated?

Although WSDOT will try to avoid or minimize effects during construction, some effects would not be possible to prevent, even with mitigation. For most of the effects described in this chapter, some residual temporary construction effects would remain. For example, mitigation measures would be in place during construction to minimize impacts due to noise and reduced pedestrian access; however, it would not be possible to avoid some effects. These effects would be relatively minor and are not expected to be substantial or long-lasting.

Appendix O, Surface Water Discipline Report

Additional information on measures to protect water quality is provided in *Appendix O*, Section 6.2.